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Ecosystem Inventory

Plant Checklist of the Bukit Nanas Forest Reserve, Kuala Lumpur, Malaysia

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Abstract

Bukit Nanas Forest Reserve, the oldest forest reserve in Malaysia established in 1900, lies in the center of Kuala Lumpur, the capital city. Over time it has been reduced from 17.5 ha to 9.37 ha but still retains important biodiversity. Its lowland equatorial rain forest has never been logged and tall emergent species to 35 m tall and 124 cm diameter persist. Since 1900, 499 plant species (2 lycophytes, 25 ferns, 39 monocots and 433 dicots) have been recorded. This year-long survey refound 425 species, including the rare *Tarenna rudis* (Rubiaceae), a local endemic found only in Selangor state. The multi-layered structure of lowland dipterocarp forest (16 Diperocarpaceae species were recorded) is intact. However, with diminishing size, the edge effect is more pronounced with secondary forest species, from trees to herbs, becoming established. In 2009, declared as the KL Forest Eco Park, it is important for its biodiversity, history, accessibility to the public for recreation (forest walks), scientific study, education (natural history, bird-watching, etc), as well as serving as a green lung in the bustling city. Baseline data, such as this survey, enables scientific management that will maintain the forest structure and biodiversity.

Keywords

Inventory, Bukit Nanas Forest Reserve, biodiversity, common species, invasive species, cultivated species

Introduction

Bukit Nanas Forest Reserve (BNFR), formerly known as the Weld Hill Forest Reserve, was gazetted in 1900 and is the oldest forest reserve in the country. In 1930, its name was changed to Bukit Nanas Forest Reserve and in 1934, it was gazetted as a Wildlife Reserve and Bird Sanctuary. In 1950, the central pristine section of about 5 ha was gazetted as a Virgin Jungle Reserve (VJR) for the purpose of research and experiment (Putz 1978). Until now, the area still remains as a VJR (JPSM 2007).

It is a historic site. During the early years of Kuala Lumpur's formation in the 19th century, there were pitched battles between Raja Mahadi bin Raja Sulaiman and Raja Abdullah bin Raja Jaafar (JPSM 2007). The forested hill was the site of a fort and, according to historical accounts, prickly pineapples ('nanas' in Malay) were planted all around the fortress to deter attackers because, at that time, soldiers were barefooted. Raja Mahadi was defeated in 1874, thus ending the war. To commemorate the war, the locals called the hill Bukit Nanas ('bukit' means hill). Recently, a 10-metre tunnel was discovered. It is believed that the tunnel was used to store weapons, food and perhaps even treasure and was part of a complex of underground tunnels that have disappeared over time with developments in the area (Nair 2015). Another suggestion is that during the Klang or Selangor Civil War between 1867 and 1874, the Mandahiling community used the narrow tunnel to launch surprise attacks or as an escape passage from their enemies.

Because of its accessibility, the forest has long suffered from encroachment and even war activities in the last forty years, it has seen many changes. In the late 1970s, the hill was the site of a small cable car project, but the project was scrapped soon after and the cable car service was shut down and dismantled (Kiew et al. 1985). City Hall relocated a troupe of silvered leaf monkeys (*Trachypithecus cristatus*) into the forest that have since become residents in the forest (The Star 1986). During 1996, about 1 ha of the area was taken up for building the KL Tower and other purposes (JPSM 2007). Today, the area of BNFR is reduced to 9.37 ha (Latiff 2010) from its original area of 17.5 ha and is now surrounded by buildings and busy roads. On 12th November 2009, Dato Sri Douglas Uggah Embas, the former Minister of Natural Resources and Environment Malaysia, officially launched this last remnant of pristine forest in Kuala Lumpur as the KL Forest Eco Park, (Latiff 2010) for three main reasons: it is the only primary lowland rain forest that still remains intact in the city; it is rich in flora and fauna (formerly it was home to the Malayan tiger and elephant, but it still harbours monkeys, pythons, squirrels, and monitor lizards and a variety of birds); and it is the oldest forest reserve in the country.

As the only remaining rain forest in the city of Kuala Lumpur, BNFR is the 'Green Lung' of Kuala Lumpur by purifying the air of its dust and toxic pollutants (Latiff 2010). It enables the general public to experience, explore and enjoy the beauty of nature. It is home to a rich variety of flora that flourishes within the forest including shrubs, trees, herbs, ferns, climbers, palms, bamboos and other indigenous plants. It is also refuge for fauna. As a recreation forest for the public, several nature trails accessible to visitors run through the forest. Facilities for visitors inside the forest include the Forest Information Centre, bird watching area, canopy walk, playground, exercise stations, picnic benches and access to the KL Tower. Entrance is free and the forest is open from 8 am until 6 pm daily.

Today, BNFR (3°09'N, 101°42'E) is a landmark in the capital city Kuala Lumpur (Fig. 1). It is a hilly area about 225 m above sea level (Putz 1978). Based on records from the Department of Forestry, the highest point on the hill itself is 280 m at the main entrance to the KL Tower. The forest experiences an equatorial climate that is hot and humid all year round. The average temperature is 26.7°C with a daily maximum of 33°C and a minimum night temperature of 24°C.

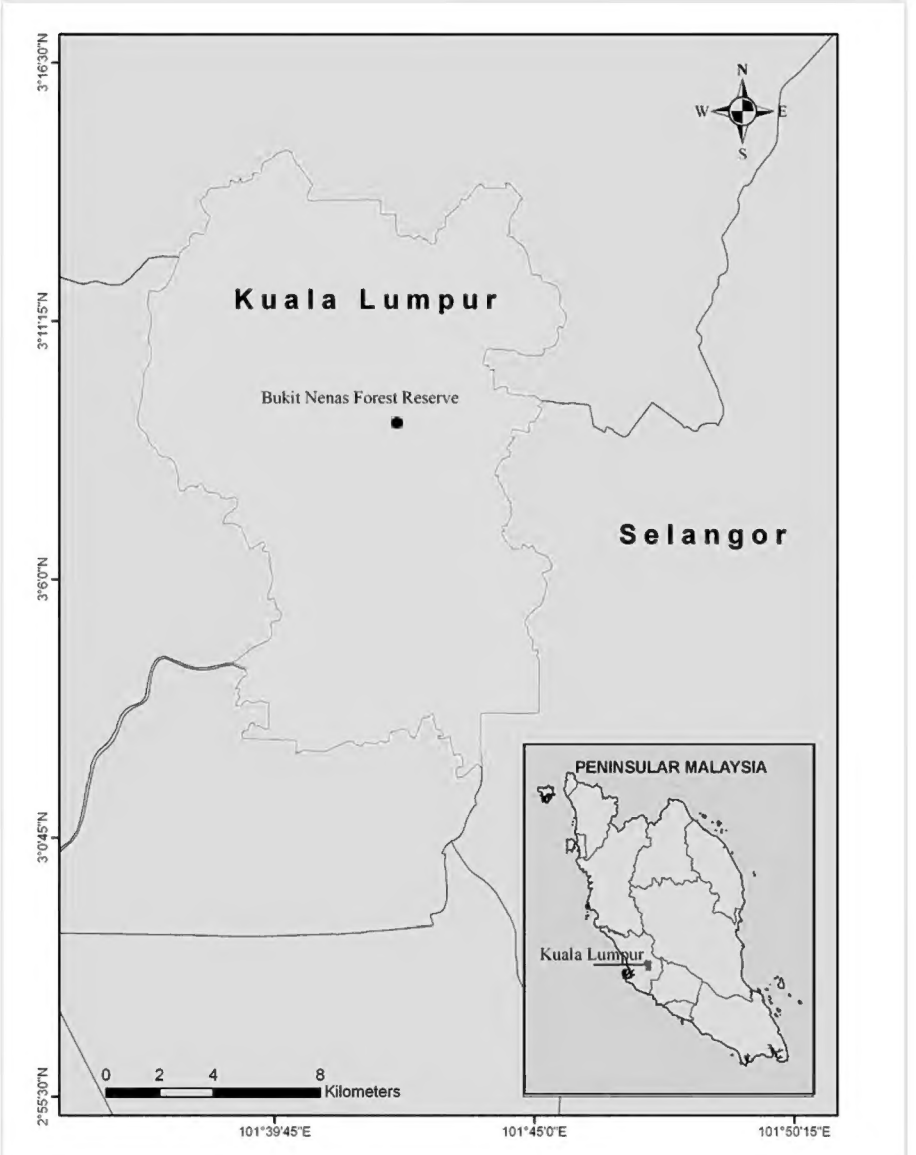

Figure 1.

Location of the Bukit Nanas Forest Reserve in Kuala Lumpur, Malaysia.

Objectives of the study

1. To make a comprehensive study of the vascular plants by collecting specimens and taking photos in BNFR.
2. To assess the biodiversity value of BNFR.
3. To assess changes in species composition in the last hundred years.
4. To identify whether weedy or alien species have started to invade the BNFR and endanger the native species.

Materials and Methods

Data collection

This checklist is specimen-based using both herbarium specimens and specimens collected during the field survey. The earliest collections date from 1901. Major collectors were forest rangers who worked in the Forest Department include Hashim bin Mohamed, Hamid bin Mohamed Sah and Ahmad bin A. Bakar. Their collections are deposited in the Herbarium of Forest Research Institute Malaysia (KEP) and also in the Herbarium of Singapore Botanic Gardens (SING). The collections in KEP used the Forest Research Institute (FRI) numbers while collections in SING used the Conservator of Forest series numbers (CF and SFN). Herbarium specimen data from KEP for the period 1901 to 2014 was accessed using the Botanical Research and Herbarium Management System (BRAHMS) database programme. Herbarium specimen data from our current survey is accessioned in BRAHMS and for vouchers (sterile specimens) in an electronic file available in Forest Research Institute Malaysia (FRIM). Existing published plant lists, those of Henderson (1928) and the Forest Department of Kuala Lumpur (JPSM 2007), in general did not cite specimen. Some specimens on Henderson's plant list were tracked down in SING. For others, identifications could not be verified so any considered doubtful were discarded.

Field survey

Field surveys were carried out three times per month from April 2015 until May 2016. Plant specimens were collected by exploring along existing paths and trails, namely the Jelutong, Penarahan, Suboh, Merawan and Arboretum Trails and the Bamboo Walk (Fig. 2) in such a way as to cover all types of terrain and habitats. Almost all the 9.37 ha of BNFR was inventoried. All species were collected when first sight or whenever there was doubt regarding their identity. Fertile specimens deposited in KEP herbarium were individually numbered using the FRI number series with data recorded in the KEP field collection book. Duplicates are deposited in the herbarium of Taman Botani Perdana, Kuala Lumpur City Hall. Sterile plant material was also collected and made into voucher specimens under a BN number series and are deposited in Taman Botani Perdana, Kuala Lumpur City Hall. The plants were pressed, dried and mounted on paper to serve as a permanent record

(Bridson and Forman 1992). In addition, spirit collection of flowers and fruits were also made. The photographic record included images of the flowers, fruits, bark, inner bark, crown and habit.

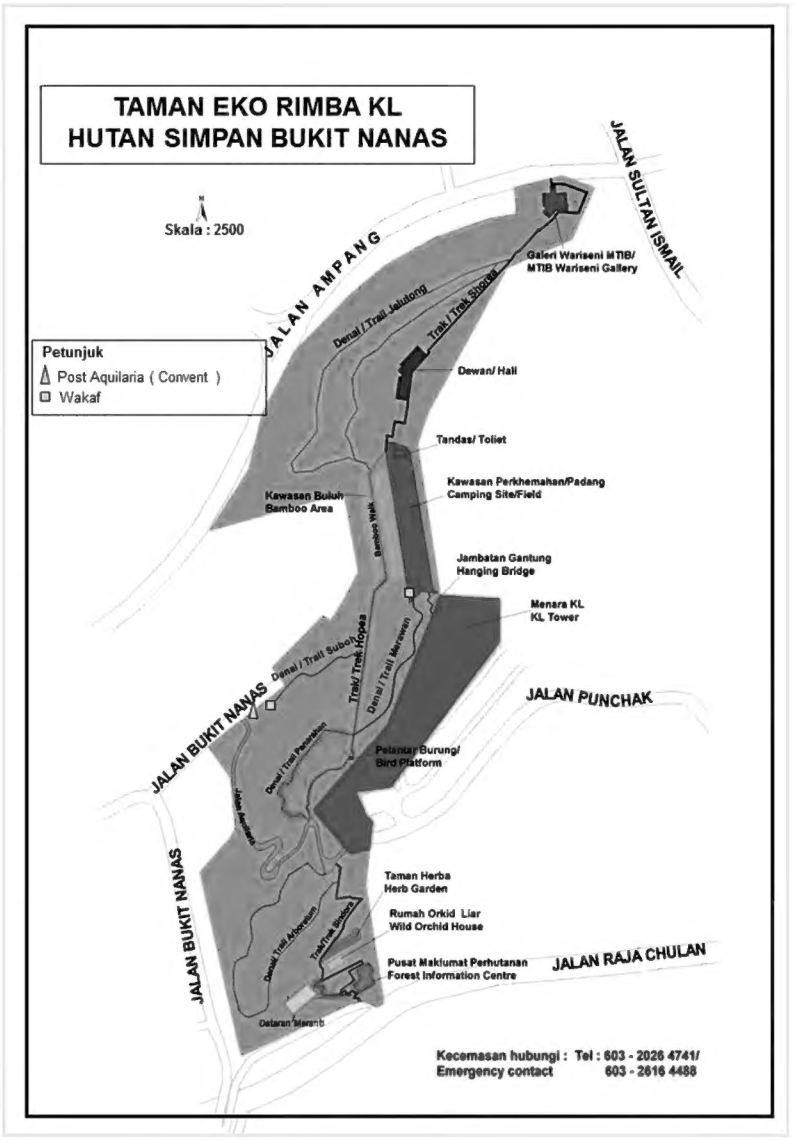

Figure 2.

The trails in the Bukit Nanas Forest Reserve, Kuala Lumpur, Malaysia (Reproduced with permission from Forestry Department Peninsular Malaysia, JPSM).

Some parts of BNFR have been cleared for the infrastructure purposes such as the canopy walk, waterfall, kiosk, and road. This might have affected several species of forest plant. Some species recorded during the JPSM 2006 survey were not recollected during our survey and might have totally disappeared because of the clearing of the forest area. There are also several species that have been wrongly identified or only identified to genus during previous surveys. These are omitted from our checklist. In addition, indigenous plants that are cultivated by the forest management have also been excluded from the checklist to avoid future confusion about which is parts of the original flora of BNFR. Weed species are also excluded.

Species identification

Identification of specimens was made with the help of expert KEP staff and/or by comparing the specimens with those in the KEP herbarium and by consulting the literature.

The main references used were the Flora of the Malay Peninsula (Ridley 1922, Ridley 1923, Ridley 1924a, Ridley 1924b, Ridley 1925), the Tree Flora of Malaya (Whitmore 1972, Whitmore 1973, Ng 1978, Ng 1989), Pocket Checklist of Timber Trees (K.M Kochummen (Wyatt-Smith 1999), Flora of Peninsular Malaysia (Kiew et al. 2010, Kiew et al. 2011, Kiew et al. 2012, Kiew et al. 2013, Kiew et al. 2015, Parris et al. 2013, Parris et al. 2010), Wayside Trees of Malaya (Corner 1988) and Plants in Tropical Cities (Min et al. 2014). Turner (Turner 1997) was used for information on species distribution. The authority of each species was checked using The Plant List (The Plant List 2016) while the name of family follow The Plant List, Turner and Flora of Peninsular Malaysia.

Endemic species are defined as being restricted to a particular place, e.g. to Peninsular Malaysia or to Selangor. Selangor is a state in Peninsular Malaysia and now surrounds the capital city of Kuala Lumpur that was once under Selangor's territorial sovereignty. *Native species* are defined as indigenous species; *naturalised species* are exotic species that are self-sustaining and have spreading populations. *Common species* are species that exist in large numbers and are abundant. *Primary species* are species that live in the undisturbed or pristine forest; *secondary species* are those that invade open areas of disturbed forest that is generally unstable and represents successional stages.

Assessment of conservation status

The conservation status assessment is based on the Malaysia Plant Red List 2010 (Peninsular Malaysia Dipterocarpaceae) that was derived from (Chua et al. 2010) and also Flora of Peninsular Malaysia (Kiew et al. 2010, Kiew et al. 2011, Kiew et al. 2012, Kiew et al. 2013, Kiew et al. 2015, Parris et al. 2013, Parris et al. 2010). The assessment was based on the baseline information contained in the Taxon Data Information Sheet (TDIS). The TDIS comprises scientific name, taxonomy details, common names, habitat preferences, geographical range, general distribution pattern, population decline, threats, Red List Category and Criteria, a rationale for the listing, current conservation measures, utilisation, literature used in assessment, details of assessor(s), date of assessment and names of evaluators. This information is to support the Red List category given to the study taxon. The categories and criteria in the taxon assessment follow the IUCN Red List Categories and Criteria version 3.1 (IUCN 2001). There are nine categories in the IUCN Red List Categories and Criteria: Extinct (EX), Extinct in the Wild (EW), Critically Endangered (CR), Endangered (EN), Vulnerable (VU), Near Threatened (NT), Least Concern (LC), Data Deficient (DD) and Not Evaluated (NE).

Results and Discussion

Collections

The flora is relatively well known botanically because prior to the establishment of the Forest Research Institute (FRI) in 1926, BNFR was the site used by the many Forest Department officers as a place to study plants (Burkill 1927). The first collections of plant

specimens from BNFR, then known as the Weld Hill Forest Reserve, were made in 1901 by Charles Curtis, an English botanist in charge of the Penang Botanic Garden, and in 1908 by Hashim bin Mohamed, a Forest Ranger with the Forest Department (Steenis-Kruseman et al. 1950). Collecting peaked between 1911 and 1920 (Fig. 3) and included 354 specimens. During 1911-1920, many collections were amassed by forest ranger Hashim bin Mohamed, Hamid bin Mohd. Sah, Abdul Rahman and Ahmad bin Abu Bakar. Their collections are deposited in KEP and SING.

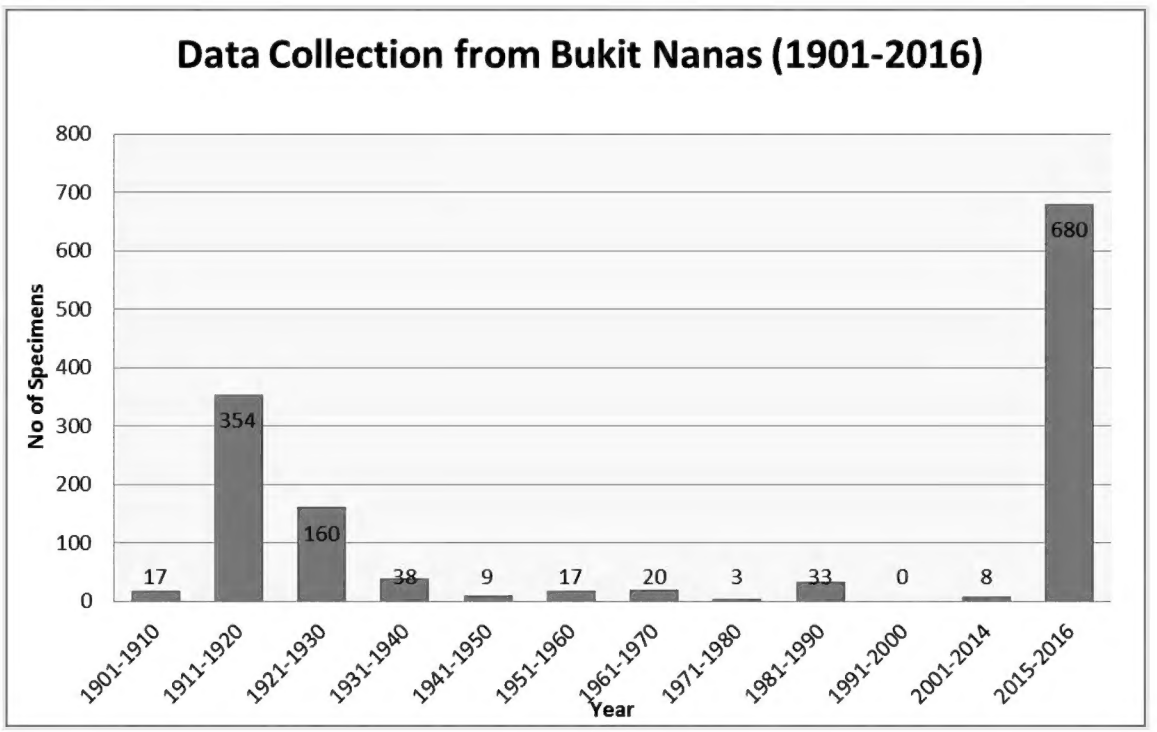

Figure 3.

Number of specimens collected from Bukit Nanas Forest Reserve by decade from 1901 to 2016 deposited in the national herbarium (KEP) at Forest Research Institute Malaysia.

Collecting between 1931-2014 continued sporadically by FRI botanists, majorly by Omar bin Mohamed, K.M. Kochummen and C.F. Symington after the establishment of Forest Research Institute (FRI). Specimens were deposited in KEP.

The 2006 survey by the Forestry Department of the Federal Territory of Kuala Lumpur (JPSM 2007) produced a list of 259 species, unfortunately without citing specimens. The third peak of collectings in 2015/2016, is our survey that collected 680 specimens of which 127 were fertile herbarium specimens and 553 were voucher specimens.

Species diversity

The checklist (Table 1) includes 499 taxa from all verifiable sources, specimens are cited whenever possible, and otherwise their record is indicated by a tick. Sources include 267 monocot and dicot species listed by Henderson (1928), 299 species collected by forest ranger and FRI botanists (1901-2014), 259 species of monocot, dicot and ferns collected by the Forest Department in 2006 (JPSM 2007) and 425 angiosperms, gymnosperms, ferns and lycophytes from our 2015/2016 survey.

Table 1.

Checklist of the taxa recorded in the Bukit Nanas Forest Reserve from 1901 to 2016 including their category (naturalised or native), (weed or forest plant) and forest type (primary or secondary).

(BRAHMS is Kepong Databases where specimens deposited in Kepong Herbarium; Hend. are Henderson survey in 1928; FD is Forest Department survey in 2006 and 15/16 are our survey in 2015-2016. Categories 1 (C1) are abbreviated as follows: T, tree; S, shrub; H, herb; C, climber; E, epiphytes; P, palms. Categories 2 (C2) are classified into two categories: naturalised and native. Forest type (FT) is abbreviated as follows: p, primary forest; s, secondary forest).

Family	Species	BRAHMS	Hend.	FD	15/16	C1	C2	FT
Angiosperms (Dicot)								
Acanthaceae	*Asystasia gangetica* (L.) T.Anders. subsp. *micrantha* (Nees) Ensermu			√	√ (BN28)	H	Naturalised	s
Acanthaceae	*Lepidagathis* sp. 1				√ (FRI84668)	H	Naturalised	s
Achariaceae	*Hydnocarpus castanea* Hook.f. & Thomson		√		√ (BN507)	T	Native	p
Achariaceae	*Hydnocarpus kunstleri* (King) Warb.	√ (KEP66647)			√ (BN375)	T	Native	p
Achariaceae	*Ryparosa fasciculata* King	√ (FRI63516)			√ (BN210)	T	Native	p
Achariaceae	*Scaphocalyx spathacea* Ridl.	√ (SFN40086)	√		√ (BN222)	T	Native	p
Anacardiaceae	*Bouea oppositifolia* (Roxb.) Adelb.	√ (FMS45820)		√	√ (BN459)	T	Native	p
Anacardiaceae	*Dracontomelon dao* (Blanco) Merr. & Rolfe		√	√	√ (BN382)	T	Native	p
Anacardiaceae	*Gluta curtisii* (Oliv.) Ding Hou			√	√ (BN320)	T	Native	p
Anacardiaceae	*Gluta malayana* (Corner) Ding Hou				√ (BN653)	T	Native	p
Anacardiaceae	*Gluta wallichii* (Hook.f.) Ding Hou				√ (BN656)	T	Native	p
Anacardiaceae	*Mangifera foetida* Lour.				√ (BN413)	T	Native	p
Anacardiaceae	*Pentaspadon motleyi* Hook.f.				√ (BN107)	T	Native	p
Anacardiaceae	*Pentaspadon velutinus* Hook.f.		√	√	√ (BN555)	T	Native	p
Annonaceae	*Alphonsea elliptica* Hook.f. & Thomson	√ (CF2832)			√ (BN671)	T	Native	p
Annonaceae	*Alphonsea maingayi* Hook.f. & Thomson	√ (CF41)	√			T	Native	p
Annonaceae	*Anaxagorea javanica* Blume				√ (BN162)	T	Native	p

Annonaceae	*Dasymaschalon dasymaschalum* (Blume) I.M.Turner				√ (BN15)	S&T	Native	p
Annonaceae	*Desmos chinensis* Lour.	√ (FMS2922)	√		√ (BN393)	S&C	Native	p
Annonaceae	*Drepananthus pruniferus* Maingay ex Hook.f. & Thomson	√ (FMS8539)	√			T	Native	p
Annonaceae	*Enicosanthum fuscum* (King) Airy Shaw	√ (FMS43630)				T	Native	p
Annonaceae	*Phaeanthus ophthalmicus* (Roxb. ex G.Don) J.Sinclair	√ (FRI26027)	√		√ (FRI83020)	T	Native	p
Annonaceae	*Polyalthia cinnamomea* Hook.f. & Thomson	√ (FMS43629)	√			T	Native	p
Annonaceae	*Polyalthia stenopetala* (Hook.f. & Thomson) Finet & Gagnep.	√ (FMS45817)			√ (BN655)	T	Native	p
Annonaceae	*Popowia pisocarpa* (Blume) Endl. ex Walp.	√ (CF2808)	√			T	Native	p
Annonaceae	*Trivalvaria macrophylla* (Blume) Miq.	√ (KEP98753)				T	Native	p
Annonaceae	*Trivalvaria nervosa* (Hook. f. & Thomson) J. Sinclair		√			T	Native	p
Annonaceae	*Uvaria wrayi* (King) L.L.Zhou, Y.C.F.Su & R.M.K.Saunders	√ (FMS4936)	√		√ (BN534)	S&C	Native	p
Annonaceae	*Xylopia malayana* Hook.f. & Thomson	√ (FMS43632)	√			T	Native	p
Annonaceae	*Xylopia subdehiscens* (King) J.Sinclair	√ (FMS10464)	√			T	Native	p
Apocynaceae	*Alstonia angustiloba* Miq.	√ (CF837)			√ (BN497)	T	Native	p
Apocynaceae	*Anodendron wrayi* King & Gamble				√ (BN427)	C	Native	p
Apocynaceae	*Chilocarpus costatus* Miq.	√ (FMS10222)	√		√ (BN479)	C	Native	p
Apocynaceae	*Dyera costulata* (Miq.) Hook.f.	√ (FMS13846)		√	√ (BN338)	T	Native	p
Apocynaceae	*Hunteria zeylanica* (Retz.) Gardner ex Thwaites	√ (FMS6406)	√		√ (BN537)	T	Native	p
Apocynaceae	*Kibatalia maingayi* (Hook.f.) Woodson	√ (FMS964)				T	Native	p
Apocynaceae	*Leuconotis griffithii* Hook.f.	√ (1664)	√			C	Native	p
Apocynaceae	*Leuconotis* sp. 1				√ (BN428)	C	Native	p
Apocynaceae	*Strophanthus caudatus* (L.) Kurz	√ (FMS1232)	√			S	Native	p
Apocynaceae	*Tabernaemontana divaricata* (L.) R.Br. ex Roem. & Schult.				√ (BN134)	S&T	Native	p

Apocynaceae	*Tabernaemontana pauciflora* Blume	√ (FMS2901)				S&T	Native	p
Apocynaceae	*Tabernaemontana peduncularis* Wall.				√ (FRI84590)	S&T	Native	p
Aquifoliaceae	*Ilex maingayi* Hook.f.	√ (232)				T	Native	p
Araliaceae	*Polyscias jackiana* (G.Don) Lowry & G.M.Plunkett	√ (KEP2882)				T	Native	s
Araliaceae	*Polyscias diversifolia* (Blume) Lowry & G.M.Plunkett			√	√ (BN668)	T	Native	p
Araliaceae	*Schefflera oxyphylla* (Miq.) R.Vig.	√ (KEP7440)	√			C	Native	p
Araliaceae	*Trevesia burckii* Boerl.	√ (KEP353)	√		√ (BN451)	S	Native	p
Aristolochiaceae	*Aristolochia acuminata* Lam.				√ (BN18)	C	Native	p
Aristolochiaceae	*Thottea piperiformis* (Griff.) Mabb.	√ (KEP1224)				S	Native	p
Aristolochiaceae	*Thottea tricornis* Maingay ex Hook.f.	√ (FMS3029)			√ (FRI83059)	S	Native	p
Bignoniaceae	*Oroxylum indicum* (L.) Kurz	√ (FMS6366)	√			T	Native	p
Burseraceae	*Canarium littorale* Blume		√	√	√ (BN37)	T	Native	p
Burseraceae	*Canarium patentinervium* Miq.	√ (CF1816)	√			T	Native	p
Burseraceae	*Canarium pilosum* A.W.Benn.	√ (CF9633)	√			T	Native	p
Burseraceae	*Dacryodes costata* (A.W.Benn.) H.J.Lam				√ (BN430)	T	Native	p
Burseraceae	*Santiria apiculata* A.W.Benn.				√ (FRI84673)	T	Native	p
Calophyllaceae	*Kayea lepidota* Pierre	√ (CF12906)				T	Native	p
Calophyllaceae	*Mesua ferrea* L.	√ (CF9525)		√	√ (BN93)	T	Native	p
Cannabaceae	*Gironniera nervosa* Planch.	√ (KEP17467)		√	√ (FRI84565)	T	Native	p
Cannabaceae	*Gironniera subaequalis* Planch.		√		√ (BN506)	T	Native	p
Cannabaceae	*Trema cannabina* Lour.				√ (FRI83049)	T	Native	p
Celastraceae	*Salacia macrophylla* Blume				√ (FRI84589)	C	Native	p
Clusiaceae	*Calophyllum canum* Hook.f. ex T.Anderson	√ (KEP99519)				T	Native	p
Clusiaceae	*Calophyllum inophyllum* L.	√ (904)			√ (BN125)	T	Native	p
Clusiaceae	*Calophyllum rubiginosum* M.R.Hend. & Wyatt-Sm.	√ (2615)				T	Native	p
Clusiaceae	*Garcinia cowa* Roxb. ex Choisy				√ (BN151)	T	Native	p

Clusiaceae	*Garcinia dumosa* King	√ (SFN40090)				T	Native	p
Clusiaceae	*Garcinia griffithii* T.Anderson				√ (BN56)	T	Native	p
Clusiaceae	*Garcinia nervosa* Miq.			√	√ (BN495)	T	Native	p
Clusiaceae	*Garcinia parvifolia* (Miq.) Miq.		√	√	√ (BN539)	T	Native	p
Clusiaceae	*Garcinia prainiana* King				√ (BN587)	T	Native	p
Clusiaceae	*Garcinia hombroniana* Pierre				√ (BN327)	T	Native	p
Combretaceae	*Combretum sundaicum* Miq.	√ (FMS11236)				S	Native	p
Combretaceae	*Terminalia bellirica* (Gaertn.) Roxb.				√ (BN674)	T	Native	p
Combretaceae	*Terminalia citrina* Roxb. ex Fleming	√ (FMS2492)	√			T	Native	p
Compositae	*Ageratum conyzoides* (L.) L.				√ (FRI83071)	H	Naturalised	s
Compositae	*Crassocephalum crepidioides* (Benth.) S.Moore				√ (FRI83029)	H	Naturalised	s
Compositae	*Vernonia arborea* Buch.-Ham.	√ (FMS128)				H	Native	p
Connaraceae	*Agelaea macrophylla* (Zoll.) Leenh.				√ (BN52)	C	Native	p
Connaraceae	*Ellipanthus tomentosus* Kurz	√ (FRI2038)				S	Native	p
Cornaceae	*Alangium ebenaceum* (C.B.Clarke) Harms	√ (KEP562)	√			T	Native	p
Cornaceae	*Alangium griffithii* (C.B.Clarke) Harms	√ (KEP8538)	√		√ (BN38)	T	Native	p
Cucurbitaceae	*Melothria pendula* L.				√ (FRI83061)	H	Naturalised	s
Dichapetalaceae	*Dichapetalum griffithii* (Hook.f.) Engl.				√ (FRI83075)	C	Native	p
Dilleniaceae	*Dillenia indica* L.	√ (FMS16470)				T	Native	p
Dilleniaceae	*Dillenia reticulata* King	√ (CF11769)		√	√ (BN266)	T	Native	p
Dilleniaceae	*Dillenia suffruticosa* (Griff.) Martelli			√	√ (FRI83043)	T	Native	s
Dilleniaceae	*Tetracera indica* (Christm. & Panz.) Merr.				√ (BN26)	C	Native	s
Dilleniaceae	*Tetracera macrophylla* Wall. ex Hook. f. & Thoms.	√ (FMS42948)				C	Native	p
Dilleniaceae	*Tetracera scandens* (L.) Merr.	√ (FMS12807)		√		C	Native	p
Dipterocarpaceae	*Anisoptera costata* Korth.	√ (32667)			√ (BN659)	T	Native	p
Dipterocarpaceae	*Anisoptera marginata* Korth.	√ (CF36029)				T	Native	p

Dipterocarpaceae	*Dipterocarpus baudii* Korth.	√ (KEP72437)	√	√	√ (FRI84566)	T	Native	p
Dipterocarpaceae	*Dipterocarpus crinitus* Dyer		√		√ (BN341)	T	Native	p
Dipterocarpaceae	*Dryobalanops aromatica* C.F.Gaertn.	√ (FMS24830)		√	√ (BN365)	T	Native	p
Dipterocarpaceae	*Hopea beccariana* Burck			√	√ (BN608)	T	Native	p
Dipterocarpaceae	*Hopea mengerawan* Miq.	√ (FMS14835)				T	Native	p
Dipterocarpaceae	*Shorea assamica* Dyer				√ (BN571)	T	Native	p
Dipterocarpaceae	*Shorea bracteolata* Dyer	√ (FMS5042)	√	√	√ (BN69)	T	Native	p
Dipterocarpaceae	*Shorea curtisii* Dyer ex King			√	√ (BN627)	T	Native	p
Dipterocarpaceae	*Shorea dasyphylla* Foxw.	√ (FMS41634)			√ (BN120)	T	Native	p
Dipterocarpaceae	*Shorea glauca* King				√ (BN94)	T	Native	p
Dipterocarpaceae	*Shorea leprosula* Miq.	√ (743)	√	√	√ (BN67)	T	Native	p
Dipterocarpaceae	*Shorea ovalis* Blume			√	√ (BN631)	T	Native	p
Dipterocarpaceae	*Shorea sumatrana* (Slooten) Desch	√ (FMS23202)		√	√ (FRI83035)	T	Native	p
Dipterocarpaceae	*Vatica odorata* (Griff.) Symington	√ (56714)				T	Native	p
Ebenaceae	*Diospyros argentea* Griff.	√ (KEP834)	√	√	√ (BN217)	T	Native	p
Ebenaceae	*Diospyros maingayi* (Hiern) Bakh.				√ (BN254)	T	Native	p
Ebenaceae	*Diospyros pendula* Hasselt ex Hassk.				√ (BN642)	T	Native	p
Ebenaceae	*Diospyros sumatrana* Miq.	√ (FMS8534)	√			T	Native	p
Ebenaceae	*Diospyros wallichii* King & Gamble	√ (FMS12904)		√	√ (FRI83062)	T	Native	p
Ebenaceae	*Diospyros lanceifolia* Roxb.	√ (KEP2484)	√			T	Native	p
Elaeocarpaceae	*Elaeocarpus ferrugineus* (Jack) Steud.	√ (CF2644)				T	Native	p
Elaeocarpaceae	*Elaeocarpus petiolatus* (Jacq.) Wall.	√ (FMS4934)		√	√ (BN548)	T	Native	p
Elaeocarpaceae	*Elaeocarpus stipularis* Blume	√ (CF899)				T	Native	p
Euphorbiaceae	*Agrostistachys gaudichaudii* Müll.Arg.				√ (BN99)	T	Native	p
Euphorbiaceae	*Balakata baccata* (Roxb.) Esser			√	√ (BN83)	T	Native	p
Euphorbiaceae	*Botryophora geniculata* (Miq.) Beumée ex Airy Shaw	√ (FMS45819)				T	Native	p

Euphorbiaceae	*Cheilosa montana* Blume	√ (FMS40625)	√			T	Native	p
Euphorbiaceae	*Elateriospermum tapos* Blume	√ (SFN40079)	√	√	√ (BN10)	T	Native	p
Euphorbiaceae	*Endospermum diadenum* (Miq.) Airy Shaw	√ (850)		√	√ (BN104)	T	Native	p
Euphorbiaceae	*Epiprinus malayanus* Griff.	√ (CF1817)	√		√ (BN340)	T	Native	p
Euphorbiaceae	*Macaranga conifera* (Rchb.f. & Zoll.) Müll.Arg.	√ (FMS2852)				T	Native	s
Euphorbiaceae	*Macaranga gigantea* (Rchb.f. & Zoll.) Müll.Arg.		√	√	√ (FRI83058)	T	Native	s
Euphorbiaceae	*Macaranga tanarius* (L.) Müll.Arg.				√ (BN198)	T	Native	s
Euphorbiaceae	*Macaranga triloba* (Thunb.) Müll.Arg.	√ (FMS43)	√	√	√ (BN215)	T	Native	s
Euphorbiaceae	*Mallotus macrostachyus* (Miq.) Müll.Arg.	√ (FMS10)				T	Native	s
Euphorbiaceae	*Mallotus paniculatus* (Lam.) Müll.Arg.	√ (FMS874)		√	√ (BN199)	T	Native	s
Euphorbiaceae	*Neoscortechinia kingii* (Hook.f.) Pax & K.Hoffm.	√ (FMS5412)				T	Native	p
Euphorbiaceae	*Pimelodendron griffithianum* (Müll.Arg.) Benth. ex Hook.f.	√ (FMS2804)		√	√ (BN589)	T	Native	p
Euphorbiaceae	*Ptychopyxis costata* Miq. var. *oblanceolata* Airy Shaw	√ (11695)	√			T	Native	p
Fagaceae	*Castanopsis inermis* (Lindl.) Benth. & Hook.f.	√ (FMS10287)	√		√ (BN637)	T	Native	p
Fagaceae	*Castanopsis javanica* (Blume) A.DC.	√ (FMS2871)	√	√	√ (BN258)	T	Native	p
Fagaceae	*Castanopsis lucida* (Nees) Soepadmo	√ (4737)				T	Native	p
Fagaceae	*Castanopsis nephelioides* King ex Hook.f.	√ (FMS1818)				T	Native	p
Fagaceae	*Castanopsis wallichii* King ex Hook.f.	√ (CF9631)				T	Native	p
Fagaceae	*Lithocarpus curtisii* (King ex Hook.f.) A.Camus	√ (FMS42949)	√			T	Native	p
Fagaceae	*Lithocarpus ewyckii* (Korth.) Rehder	√ (KEP861)				T	Native	p
Gentianaceae	*Fagraea auriculata* Jack	√ (908)				T	Native	p
Gentianaceae	*Fagraea racemosa* Jack		√		√ (FRI84675)	T	Native	p
Hypericaceae	*Cratoxylum cochinchinense* (Lour.) Blume	√ (FMS926)	√			T	Native	p

Hypericaceae	*Cratoxylum formosum* (Jacq.) Benth. & Hook.f. ex Dyer	√ (66452)		√		T	Native	p
Icacinaceae	*Phytocrene bracteata* Wall.				√ (BN345)	T	Native	p
Ixonanthaceae	*Ixonanthes icosandra* Jack	√ (CF586)	√	√	√ (FRI83053)	T	Native	p
Ixonanthaceae	*Ixonanthes reticulata* Jack	√ (FMS40631)	√		√ (BN304)	T	Native	p
Lamiaceae	*Clerodendrum deflexum* Wall.		√		√ (FRI84583)	T	Native	p
Lamiaceae	*Clerodendrum villosum* Blume	√ (FMS8510)	√			T	Native	p
Lamiaceae	*Rotheca serrata* (L.) Steane & Mabb.	√ (CF2878)	√			T	Native	p
Lamiaceae	*Vitex gamosepala* Griff.				√ (BN73)	T	Native	s
Lamiaceae	*Vitex longisepala* King & Gamble	√ (CF15349)				T	Native	p
Lamiaceae	*Vitex vestita* Wall. ex Schauer	√ (CF2951)				T	Native	p
Lauraceae	*Actinodaphne macrophylla* (Blume) Nees	√ (FRI2036)		√	√ (FRI84580)	T	Native	p
Lauraceae	*Actinodaphne sesquipedalis* Hook.f. & Thomson ex Meisn.	√ (CF607)	√		√ (BN227)	T	Native	p
Lauraceae	*Alseodaphne peduncularis* (Wall. ex Nees) Meisn.	√ (FMS9565)				T	Native	p
Lauraceae	*Beilschmiedia madang* Blume	√ (66648)				T	Native	p
Lauraceae	*Beilschmiedia perakensis* Gamble	√ (FMS2803)	√			T	Native	p
Lauraceae	*Cinnamomum iners* Reinw.	√ (CF583)				T	Native	p
Lauraceae	*Cryptocarya griffithiana* Wight	√ (FMS12647)				T	Native	p
Lauraceae	*Cryptocarya nitens* (Blume) Koord. & Valeton	√ (CF977)	√			T	Native	p
Lauraceae	*Lauraceae* sp. 1				√ (BN614)	T	Native	p
Lauraceae	*Lindera lucida* Boerl.	√ (CF851)				T	Native	p
Lauraceae	*Litsea castanea* Hook.f.	√ (FRI2030)		√	√ (FRI84670)	T	Native	p
Lauraceae	*Litsea costalis* (Nees) Kosterm.	√ (FMS2914)	√		√ (FRI84578)	T	Native	p
Lauraceae	*Litsea elliptica* Blume	√ (FMS10938)	√	√	√ (BN561)	T	Native	p
Lauraceae	*Litsea ferruginea* Blume	√ (FMS5028)	√			T	Native	p
Lauraceae	*Litsea* sp. 1				√ (BN556)	T	Native	p
Lauraceae	*Litsea spathacea* Gamble	√ (CF860)				T	Native	p

Lauraceae	*Litsea tomentosa* Blume	√ (975)	√			T	Native	p
Lauraceae	*Litsea umbellata* (Lour.) Merr.	√ (FMS11718)	√			T	Native	p
Lauraceae	*Neolitsea zeylanica* (Nees & T. Nees) Merr.	√ (CF871)	√			T	Native	p
Lauraceae	*Nothaphoebe umbelliflora* (Blume) Blume		√		√ (BN352)	T	Native	p
Lauraceae	*Phoebe elliptica* (Blume) Blume	√ (CF7971)				T	Native	p
Lauraceae	*Phoebe grandis* (Nees) Merr.	√ (FMS3010)	√		√ (BN485)	T	Native	p
Lecythidaceae	*Barringtonia fusiformis* King				√ (BN187)	T	Native	p
Lecythidaceae	*Barringtonia macrostachya* (Jack) Kurz	√ (CF915)	√		√ (BN457)	T	Native	p
Lecythidaceae	*Barringtonia scortechinii* King	√ (FMS11693)	√			T	Native	p
Leguminosae	*Albizia splendens* Miq.	√ (FMS2822)	√			T	Native	p
Leguminosae	*Archidendron bubalinum* (Jack) I.C.Nielsen	√ (FMS45822)	√	√		T	Native	p
Leguminosae	*Archidendron clypearia* (Jack) I.C.Nielsen	√ (FRI16586)	√			T	Native	p
Leguminosae	*Archidendron ellipticum* (Blanco) I.C.Nielsen	√ (FMS2809)	√			T	Native	p
Leguminosae	*Archidendron jiringa* (Jack) I.C.Nielsen		√	√	√ (BN273)	T	Native	p
Leguminosae	*Bauhinia audax* (de Wit) G.Cusset	√ (FMS2473)	√			T	Native	p
Leguminosae	*Bauhinia integrifolia* Roxb.	√ (CF7957)	√		√ (BN453)	T	Native	p
Leguminosae	*Callerya atropurpurea* (Wall.) Schot			√	√ (BN572)	T	Native	p
Leguminosae	*Crudia curtisii* Prain	√ (CF576)				T	Native	p
Leguminosae	*Cynometra cauliflora* L.				√ (BN172)	T	Native	p
Leguminosae	*Cynometra malaccensis* Meeuwen	√ (CF832)		√	√ (BN259)	T	Native	p
Leguminosae	*Dialium platysepalum* Baker				√ (FRI84671)	T	Native	p
Leguminosae	*Falcataria moluccana* (Miq.) Barneby & J.W.Grimes	√ (FMS2867)		√	√ (BN31)	T	Native	p
Leguminosae	*Fordia albiflora* (Prain) Dasuki & Schot	√ (FMS10465)				T	Native	p
Leguminosae	*Intsia bijuga* (Colebr.) Kuntze				√ (BN213)	T	Native	p
Leguminosae	*Ormosia polita* Prain	√ (CF2866)	√			T	Native	p

Leguminosae	*Parkia speciosa* Hassk.	√ (CF2858)		√	√ (FRI84551)	T	Native	p
Leguminosae	*Saraca declinata* Miq.				√ (BN570)	T	Native	p
Leguminosae	*Senna sulfurea* (Collad.) H.S.Irwin & Barneby	√ (FMS1197)				T	Naturalised	s
Leguminosae	*Senna hirsuta* (L.) H.S.Irwin & Barneby	√ (CF2884)	√			T	Naturalised	s
Leguminosae	*Sindora coriacea* (Baker) Prain			√	√ (BN516)	T	Native	p
Leguminosae	*Sindora wallichii* Benth.	√ (CF10466)				T	Native	p
Loganiaceae	*Norrisia maior* Soler.	√ (FMS43)			√ (BN470)	T	Native	p
Loranthaceae	*Scurrula ferruginea* (Jack) Danser				√ (BN615)	E	Native	s
Magnoliaceae	*Magnolia montana* (Blume) Figlar				√ (FRI83040)	T	Native	p
Malvaceae	*Coelostegia griffithii* Benth.				√ (BN494)	T	Native	p
Malvaceae	*Commersonia bartramia* (L.) Merr.	√ (CF898)				T	Native	s
Malvaceae	*Durio griffithii* (Mast.) Bakh.	√ (FMS42950)	√	√	√ (FRI83067)	T	Native	p
Malvaceae	*Grewia laevigata* Vahl				√ (BN504)	T	Native	p
Malvaceae	*Hibiscus macrophyllus* Roxb. ex Hornem.		√	√		T	Native	p
Malvaceae	*Kostermansia malayana* Soegeng			√	√	T	Native	p
Malvaceae	*Microcos tomentosa* Sm.			√	√ (BN34)	T	Native	s
Malvaceae	*Neesia malayana* Bakh.			√	√ (BN649)	T	Native	p
Malvaceae	*Pterocymbium tinctorium* (Blanco) Merr.		√		√ (BN214)	T	Native	p
Malvaceae	*Scaphium macropodum* (Miq.) Beumée ex K.Heyne		√		√ (BN128)	T	Native	p
Malvaceae	*Schoutenia accrescens* (Mast.) Curtis				√ (BN137)	T	Native	p
Malvaceae	*Sterculia coccinea* Jack				√ (FRI84582)	T	Native	p
Malvaceae	*Sterculia cordata* Blume				√ (BN331)	T	Native	p
Malvaceae	*Sterculia hispidissima* Ridl.				√ (BN408)	T	Native	p
Malvaceae	*Sterculia megistophylla* Ridl.				√ (BN518)	T	Native	p
Malvaceae	*Sterculia parviflora* Roxb.		√		√ (BN523)	T	Native	p
Malvaceae	*Sterculia rubiginosa* Vent.		√		√ (BN264)	T	Native	p
Malvaceae	*Thespesia populnea* (L.) Sol. ex Corrêa				√ (BN367)	T	Native	p

Melastomataceae	*Dissochaeta intermedia* Blume var. *intermedia*				√ (FRI84672)	T	Native	p
Melastomataceae	*Memecylon campanulatum* C.B.Clarke				√ (BN219)	T	Native	p
Melastomataceae	*Memecylon excelsum* Blume				√ (BN376)	T	Native	p
Melastomataceae	*Memecylon lilacinum* Zoll. & Moritzi	√ (FRI32199)	√		√ (FRI84669)	T	Native	p
Melastomataceae	*Oxyspora bullata* J.F.Maxwell	√ (SFN40084)		√	√ (FRI84557)	T	Native	p
Melastomataceae	*Phyllagathis rotundifolia* (Jack) Blume			√	√ (BN163)	T	Native	p
Melastomataceae	*Pternandra echinata* Wall.			√	√	T	Native	p
Meliaceae	*Aglaia edulis* (Roxb.) Wall.	√ (FMS2814)				T	Native	p
Meliaceae	*Aglaia lawii* (Wight) C.J.Saldanha ex Ramamoorthy	√ (CF809)	√			T	Native	p
Meliaceae	*Aglaia leucophylla* King	√ (CF2819)				T	Native	p
Meliaceae	*Aglaia tenuicaulis* Hiern	√ (CF2479)	√			T	Native	p
Meliaceae	*Aphanamixis polystachya* (Wall.) R.Parker	√ (FMS12909)	√			T	Native	p
Meliaceae	*Azadirachta excelsa* (Jack) Jacobs				√ (BN629)	T	Native	p
Meliaceae	*Chisocheton ceramicus* Miq.	√ (FMS2844)				T	Native	p
Meliaceae	*Chisocheton patens* Blume	√ (FMS10463)			√ (BN260)	T	Native	p
Meliaceae	*Chisocheton sarawakanus* (C.DC.) Harms	√ (FMS1837)				T	Native	p
Meliaceae	*Chisocheton* sp. 1				√ (BN634)	T	Native	p
Meliaceae	*Dysoxylum densiflorum* (Blume) Miq.	√ (CF868)				T	Native	p
Meliaceae	*Dysoxylum excelsum* Blume	√ (FMS256)	√			T	Native	p
Meliaceae	*Dysoxylum grande* Hiern	√ (KEP2433)				T	Native	p
Meliaceae	*Melia azedarach* L.	√ (CF864)				T	Native	p
Meliaceae	*Sandoricum koetjape* (Burm.f.) Merr.	√ (KEP66451)		√	√ (BN88)	T	Native	p
Meliaceae	*Toona sureni* (Blume) Merr.			√	√ (BN652)	T	Native	p
Menispermaceae	*Coscinium fenestratum* (Goetgh.) Colebr			√	√ (BN492)	C	Native	p
Menispermaceae	*Fibraurea tinctoria* Lour.			√	√ (FRI84572)	C	Native	p
Moraceae	*Antiaris toxicaria* Lesch.				√ (BN423)	T	Native	p

Moraceae	*Artocarpus dadah* Miq.				√ (BN79)	T	Native	p
Moraceae	*Artocarpus elasticus* Reinw. ex Blume			√	√ (BN512)	T	Native	p
Moraceae	*Artocarpus heterophyllus* Lam.				√ (FRI84595)	T	Native	p
Moraceae	*Artocarpus hispidus* F.M.Jarrett				√ (BN51)	T	Native	p
Moraceae	*Artocarpus integer* (Thunb.) Merr.				√ (BN632)	T	Native	p
Moraceae	*Artocarpus nitidus* Trécul	√ (FMS10268)		√	√ (BN201)	T	Native	p
Moraceae	*Artocarpus rigidus* Blume				√ (FRI83042)	T	Native	p
Moraceae	*Artocarpus scortechinii* King				√ (BN378)	T	Native	p
Moraceae	*Ficus aurata* (Miq.) Miq.	√ (CF819)	√			T	Native	s
Moraceae	*Ficus chartacea* (Wall. ex Kurz) Wall. ex King	√ (FMS8503)			√ (BN57)	T	Native	p
Moraceae	*Ficus deltoidea* Jack				√ (BN136)	T	Native	p
Moraceae	*Ficus glandulifera* (Wall. ex Miq.) King	√ (FMS5426)	√		√ (BN48)	T	Native	p
Moraceae	*Ficus globosa* Blume	√ (FMS4701)				T	Native	p
Moraceae	*Ficus grossularioides* Burm.f.				√ (FRI83068)	T	Native	s
Moraceae	*Ficus hispida* L.f.	√ (FMS12809)	√	√		T	Native	p
Moraceae	*Ficus lepicarpa* Blume				√ (BN29)	T	Native	p
Moraceae	*Ficus microcarpa* L.f.				√ (BN122)	T	Native	p
Moraceae	*Ficus punctata* Thunb.	√ (KEP93476)			√ (BN354)	T	Native	p
Moraceae	*Ficus scortechinii* King	√ (CF2337)				T	Native	p
Moraceae	*Ficus variegata* Blume.				√ (FRI84568)	T	Native	p
Moraceae	*Ficus vasculosa* Wall. ex Miq.	√ (TN289)	√		√ (FRI84552)	T	Native	p
Moraceae	*Streblus elongatus* (Miq.) Corner	√ (CF15387)	√	√	√ (BN425)	T	Native	p
Myristicaceae	*Endocomia canarioides* (King) W.J.de Wilde				√ (BN164)	T	Native	p
Myristicaceae	*Horsfieldia irya* (Gaertn.) Warb.				√ (BN588)	T	Native	p
Myristicaceae	*Horsfieldia majuscula* Warb.				√ (BN268)	T	Native	p
Myristicaceae	*Horsfieldia punctatifolia* J.Sinclair	√ (KEP76145)				T	Native	p

Myristicaceae	*Horsfieldia sparsa* W.J.de Wilde	√ (FMS11697)				T	Native	p
Myristicaceae	*Horsfieldia superba* Warb.	√ (CF7973)	√			T	Native	p
Myristicaceae	*Knema furfuracea* (Hook. f. & Thomson) Warb.	√ (CF934)	√			T	Native	p
Myristicaceae	*Knema malayana* Warb.	√ (CF825)				T	Native	p
Myristicaceae	*Knema patentinervia* (J.Sinclair) W.J.de Wilde	√ (CF561)			√ (BN232)	T	Native	p
Myristicaceae	*Knema pseudolaurina* W.J.de Wilde	√ (FMS40627)			√ (BN233)	T	Native	p
Myrsinaceae	*Ardisia sessilis* Scheff.	√ (KEP17468)				T	Native	p
Myrtaceae	*Decaspermum fruticosum* J.R.Forst. & G.Forst.	√ (FMS5411)				T	Native	s
Myrtaceae	*Rhodamnia cinerea* Jack	√ (KEP8526)		√	√ (BN82)	T	Native	p
Myrtaceae	*Syzygium* sp. 7	√ (FMS10211)				T	Native	p
Myrtaceae	*Syzygium polyanthum* (Wight) Walp. var. *polyanthum*	√ (CF855)	√		√ (FRI84653)	T	Native	p
Myrtaceae	*Syzygium* sp. 1				√ (BN387)	T	Native	p
Myrtaceae	*Syzygium* sp. 2				√ (BN456)	T	Native	p
Myrtaceae	*Syzygium* sp. 3				√ (BN540)	T	Native	p
Myrtaceae	*Syzygium* sp. 4				√ (BN569)	T	Native	p
Myrtaceae	*Syzygium* sp. 5				√ (BN654)	T	Native	p
Myrtaceae	*Syzygium* sp. 6				√ (BN670)	T	Native	p
Myrtaceae	*Syzygium attenuatum* (Miq.) Merr. & L.M.Perry				√ (BN197)	T	Native	p
Myrtaceae	*Syzygium borneense* (Miq.) Miq.	√ (FMS6407)	√			T	Native	p
Myrtaceae	*Syzygium diospyrifolium* (Wall. ex Duthie) S.N.Mitra				√ (BN660)	T	Native	p
Myrtaceae	*Syzygium fastigiatum* (Blume) Merr. & L.M.Perry	√ (FMS5191)				T	Native	p
Myrtaceae	*Syzygium filiforme* Wall. ex Duthie var. *clavimyrtus* I.M.Turner	√ (FMS894)				T	Native	p
Myrtaceae	*Syzygium grande* (Wight) Walp.				√ (FRI83015)	T	Native	p
Myrtaceae	*Syzygium inophyllum* DC.	√ (FRI2033)			√ (FRI83065)	T	Native	p
Myrtaceae	*Syzygium jasminifolium* (Ridl.) Chantaran. & J.Parn.	√ (FRI53229)				T	Native	p

Myrtaceae	*Syzygium malaccense* (L.) Merr. & L.M.Perry				√ (BN156)	T	Native	p
Myrtaceae	*Syzygium scortechinii* (King) Chantaran. & J.Parn.	√ (FMS2934)	√			T	Native	p
Myrtaceae	*Syzygium subdecussatum* (Duthie) I.M.Turner	√ (FMS1010)	√		√ (BN78)	T	Native	p
Olacaceae	*Erythropalum scandens* Blume				√ (BN288.1)	T	Native	p
Olacaceae	*Ochanostachys amentacea* Mast.	√ (KEP72438)		√	√ (BN58)	T	Native	p
Olacaceae	*Strombosia javanica* Blume	√ (CF2817)	√	√	√ (BN13)	T	Native	p
Onagraceae	*Ludwigia hyssopifolia* (G.Don) Exell				√ (FRI83072)	H	Naturalised	s
Opiliaceae	*Champereia manillana* (Blume) Merr.	√ (CF1666)	√	√	√ (BN22)	T	Native	p
Opiliaceae	*Lepionurus sylvestris* Blume	√ (CF7954)	√			T	Native	p
Pandaceae	*Galearia fulva* (Tul.) Miq.	√ (KEP1786)	√	√	√ (FRI83024)	T	Native	p
Pandaceae	*Microdesmis caseariifolia* Planch. ex Hook.	√ (TN223)		√	√	T	Native	p
Passifloraceae	*Paropsia varecifomis* (Griff.) Mast.		√	√	√ (BN278)	T	Native	p
Actinidiaceae	*Saurauia pentapetala* (Jack) Hoogland	√ (FMS4574)				T	Native	p
Phyllanthaceae	*Antidesma cuspidatum* Müll.Arg.	√ (FMS12903)			√ (FRI84556)	T	Native	p
Phyllanthaceae	*Aporosa aurea* Hook.f.		√		√ (FRI84559)	T	Native	p
Phyllanthaceae	*Aporosa benthamiana* Hook.f.	√ (FMS4739)	√		√ (BN312)	T	Native	p
Phyllanthaceae	*Aporosa frutescens* Blume				√ (BN161)	T	Native	p
Phyllanthaceae	*Aporosa miqueliana* Müll.Arg.	√ (FMS4935)	√			T	Native	p
Phyllanthaceae	*Aporosa penangensis* (Ridl.) Airy Shaw	√ (CF11688)				T	Native	p
Phyllanthaceae	*Aporosa stellifera* Hook.f.	√ (FMS15350)				T	Native	p
Phyllanthaceae	*Aporosa bracteosa* Pax & K.Hoffm.	√ (FMS4576)				T	Native	p
Phyllanthaceae	*Aporosa symplocoides* (Hook.f.) Gage	√ (CF217)	√			T	Native	p
Phyllanthaceae	*Baccaurea brevipes* Hook.f.	√ (FMS8505)	√		√	T	Native	p
Phyllanthaceae	*Baccaurea macrophylla* (Müll.Arg.) Müll.Arg.	√ (CF924)		√		T	Native	p

Phyllanthaceae	*Baccaurea motleyana* (Müll.Arg.) Müll.Arg.				√ (BN44)	T	Native	p
Phyllanthaceae	*Baccaurea parviflora* (Müll.Arg.) Müll.Arg.			√	√ (BN225)	T	Native	p
Phyllanthaceae	*Baccaurea kunstleri* King ex Gage	√ (FMS2879)	√			T	Native	p
Phyllanthaceae	*Baccaurea hookeri* Gage	√ (FMS2838)				T	Native	p
Phyllanthaceae	*Bridelia tomentosa* Blume	√ (CF804)			√ (BN284)	T	Native	s
Phyllanthaceae	*Glochidion glomerulatum* (Miq.) Boerl.	√ (FMS2906)	√			T	Native	p
Phyllanthaceae	*Glochidion hypoleucum* (Miq.) Boerl.	√ (CF893)				T	Native	p
Phyllanthaceae	*Glochidion obscurum* (Roxb. ex Willd.) Blume	√ (FMS12808)				T	Native	p
Phyllanthaceae	*Glochidion rubrum* Blume				√ (BN482)	T	Native	p
Phyllanthaceae	*Glochidion superbum* Baill. ex Müll.Arg.	√ (CF907)		√		T	Native	p
Phyllanthaceae	*Phyllanthus niruri* L.				√ (FRI83039)	H	Native	s
Phyllanthaceae	*Sauropus androgynus* (L.) Merr.				√ (FRI83045)	T	Native	p
Piperaceae	*Piper caninum* Blume	√ (FMS8533)	√		√ (FRI84584)	H	Native	p
Piperaceae	*Piper porphyrophyllum* N.E.Br.	√ (CF568)	√			H	Native	p
Piperaceae	*Piper sarmentosum* Roxb.			√	√ (BN91)	H	Native	p
Polygalaceae	*Xanthophyllum maingayi* Benn.	√ (CF846)	√			T	Native	p
Polygalaceae	*Xanthophyllum griffithii* Hook.f. ex A.W.Benn.	√ (FMS905)				T	Native	p
Polygalaceae	*Xanthophyllum stipitatum* A.W.Benn.	√ (CF606)				T	Native	p
Polygalaceae	*Xanthophyllum flavescens* Roxb.	√ (CF2483)			√ (FRI84594)	T	Native	p
Polygalaceae	*Xanthophyllum venosum* King	√ (FMS11715)				T	Native	p
Primulaceae	*Ardisia colorata* Roxb.		√		√ (FRI84652)	T	Native	p
Primulaceae	*Ardisia pachysandra* (Wall.) Mez	√ (KEP2805)	√			T	Native	p
Primulaceae	*Maesa ramentacea* (Roxb.) A. DC.	√ (KEP12901)				T	Native	p
Rhamnaceae	*Gouania javanica* Miq.	√ (FMS2345)	√				Native	p

Rhamnaceae	*Ventilago gladiata* Pierre	√ (FRI29246)			√ (BN452)	C	Native	p
Rhamnaceae	*Ventilago oblongifolia* Blume	√ (FMS2481)	√			C	Native	p
Rhizophoraceae	*Carallia suffruticosa* Ridl.		√		√ (BN546)	T	Native	p
Rhizophoraceae	*Gynotroches axillaris* Blume				√ (BN467)	T	Native	p
Rhizophoraceae	*Pellacalyx saccardianus* Scort.	√ (FMS32668)			√ (BN272)	T	Native	p
Rosaceae	*Prunus polystachya* (Hook.f.) Kalkman	√ (TN222)			√ (BN308)	T	Native	p
Rosaceae	*Rosaceae* sp. 1				√ (BN582)	T	Native	p
Rubiaceae	*Canthium depressinerve* Ridl.	√ (CF668)				T	Native	p
Rubiaceae	*Ixora kingstonii* Hook.f.	√ (KEP4941)				T	Native	p
Rubiaceae	*Aidia densiflora* (Wall.) Masam.	√ (FRI32200)		√	√ (FRI83054)	T	Native	p
Rubiaceae	*Canthium confertum* Korth.	√ (KEP4577)	√			T	Native	p
Rubiaceae	*Canthium glabrum* Blume	√ (KEP2592)	√			T	Native	p
Rubiaceae	*Canthium horridum* Blume		√		√ (FRI84592)	T	Native	p
Rubiaceae	*Chassalia chartacea* Craib	√ (KEP992)		√	√ (BN020)	T	Native	p
Rubiaceae	*Greenea commersonii* (Korth.) Tange ex Ruhsam	√ (KEP8248)				T	Native	s
Rubiaceae	*Greenea corymbosa* (Jack) Voigt	√ (914)	√	√	√ (BN102)	T	Native	s
Rubiaceae	*Guettarda speciosa* L.				√ (BN212)	T	Native	p
Rubiaceae	*Hedyotis philippinensis* (Willd. ex Spreng.) Merr. ex C.B.Rob.				√ (BN388)	H	Native	s
Rubiaceae	*Ixora congesta* Roxb.	√ (KEP1783)			√ (BN437)	S	Native	p
Rubiaceae	*Ixora pendula* Jack	√ (KEP2406)	√	√		S	Native	p
Rubiaceae	*Lasianthus oblongus* King & Gamble	√ (976)	√			T	Native	p
Rubiaceae	*Metadina trichotoma* (Zoll. & Moritzi) Bakh.f.		√		√ (BN618)	T	Native	p
Rubiaceae	*Morinda citrifolia* L.				√ (BN180)	T	Native	s
Rubiaceae	*Mussaenda maingayi* (Hook.f.) Hemsl. ex B.D.Jacks.	√ (KEP3896)				T	native	s
Rubiaceae	*Nauclea orientalis* (L.) L.				√ (BN515)	T	Native	p
Rubiaceae	*Hedyotis dichotoma* Cav.				√ (FRI83069)	H	Native	s
Rubiaceae	*Oxyceros fragrantissimus* (Ridl.) K.M.Wong				√ (BN601)	T	Native	p

Rubiaceae	*Pertusadina eurhyncha* (Miq.) Ridsdale	√ (KEP40637)	√	√	√ (BN223)	T	Native	p
Rubiaceae	*Porterandia anisophylla* (Jack ex Roxb.) Ridl.	√ (KEP11723)				T	Native	p
Rubiaceae	*Psychotria penangiana* (BRAHMS)	√ (KEP2900)				S	Native	p
Rubiaceae	*Psychotria viridiflora* Reinw. ex Blume		√		√ (FRI84579)	S	Native	p
Rubiaceae	*Psydrax nitidum* (Craib) K.M.Wong				√ (FRI83022)	S	Native	p
Rubiaceae	Rubiaceae sp. 1				√ (BN298)	S	Native	p
Rubiaceae	Rubiaceae sp. 2				√ (BN410)	S	Native	p
Rubiaceae	*Tarenna rudis* Ridl.		√		√ (FRI84591)	S	Native	p
Rubiaceae	*Timonius wallichianus* (Korth.) Valeton	√ (FRI32201)	√	√	√ (FRI84563)	S	Native	p
Rubiaceae	*Uncaria tomentosa* (Willd. ex Schult.) DC.			√	√ (BN473)	C	Native	p
Rubiaceae	*Urophyllum glabrum* Jack ex Wall.		√		√ (FRI83074)	S	Native	p
Rubiaceae	*Urophyllum blumeanum* (Wight) Hook.f.	√ (FMS84)				S	Native	p
Rutaceae	*Glycosmis chlorosperma* (Blume) Spreng.	√ (FRI16588)	√		√ (FRI84574)	T	Native	p
Rutaceae	*Maclurodendron porteri* (Hook. f.) T.G. Hartley	√ (KEP99520)	√	√	√ (BN165)	T	Native	p
Rutaceae	*Melicope glabra* (Blume) T.G. Hartley	√ (FMS2452)	√	√		T	Native	p
Rutaceae	*Melicope latifolia* (DC.) T.G. Hartley	√ (FMS11701)				T	Native	p
Rutaceae	*Melicope macrocarpa* (King) T.G. Hartley	√ (FMS2828)				T	Native	p
Rutaceae	*Micromelum minutum* Wight & Arn.				√ (BN116)	T	Native	p
Rutaceae	*Murraya koenigii* (L.) Spreng.				√ (BN360)	T	Native	p
Salicaceae	*Casearia capitellata* Blume	√ (CF259)				T	Native	p
Salicaceae	*Casearia clarkei* var. *kunstleri* (King) Ridl.	√ (CF827)	√			T	Native	p
Salicaceae	*Flacourtia rukam* Zoll. & Moritzi				√ (FRI84667)	T	Native	p
Salicaceae	*Homalium grandiflorum* Benth.	√ (CF608)	√			T	Native	p
Sapindaceae	*Pometia pinnata* J.R.Forst. & G.Forst.	√ (FMS4965)	√	√	√ (BN132)	T	Native	p

Sapindaceae	*Arytera littoralis* Blume	√ (CF85)			√ (FRI84654)	T	Native	p
Sapindaceae	*Lepisanthes amoena* (Hassk.) Leenh.	√ (CF884)				T	Native	p
Sapindaceae	*Lepisanthes fruticosa* (Roxb.) Leenh.	√ (CF2826)	√		√ (BN476)	T	Native	p
Sapindaceae	*Lepisanthes rubiginosa* (Roxb.) Leenh.			√	√ (BN76)	T	Native	p
Sapindaceae	*Lepisanthes tetraphylla* Radlk.	√ (FMS10218)				T	Native	p
Sapindaceae	*Mischocarpus pentapetalus* (Roxb.) Radlk.	√ (KEP45818)				T	Native	p
Sapindaceae	*Nephelium cuspidatum* Blume		√		√ (BN478)	T	Native	p
Sapindaceae	*Nephelium maingayi* Hiern.	√ (TN77)			√ (BN595)	T	Native	p
Sapindaceae	*Xerospermum laevigatum* Radlk.				√ (BN305)	T	Native	p
Sapindaceae	*Xerospermum intermedium* Radlk.	√ (KEP1002)				T	Native	p
Sapindaceae	*Xerospermum noronhianum* Blume	√ (CF1002)	√	√		T	Native	p
Sapotaceae	*Chrysophyllum lanceolatum* A.DC.	√ (KEP5404)	√			T	Native	p
Sapotaceae	*Madhuca korthalsii* (Pierre ex Burck) H.J.Lam	√ (KEP8522)	√		√ (BN513)	T	Native	p
Sapotaceae	*Madhuca malaccensis* (C.B.Clarke) H.J.Lam		√		√ (BN650)	T	Native	p
Sapotaceae	*Palaquium gutta* (Hook.) Baill.	√ (KEP3897)	√	√	√ (BN480)	T	Native	
Sapotaceae	*Palaquium maingayi* (C.B.Clarke) Engl.	√ (KEP11716)		√	√ (BN445)	T	Native	p
Sapotaceae	*Palaquium obovatum* (Griff.) Engl.	√ (FRI2035)	√	√	√ (BN9)	T	Native	p
Sapotaceae	*Palaquium oxleyanum* Pierre	√ (KEP4940)				T	Native	p
Sapotaceae	*Payena lucida* A.DC.	√ (KEP823)	√			T	Native	p
Sapotaceae	*Pouteria maingayi*	√ (FRI2034)				T	Native	p
Sapotaceae	*Pouteria malaccensis* (C.B.Clarke) Baehni	√ (KEP11724)	√		√ (BN651)	T	Native	p
Staphyleaceae	*Dalrympelea sphaerocarpa* (Hassk.) Nor-Ezzaw.	√ (CF64)				T	Native	p
Stemonuraceae	*Gomphandra quadrifida* (Blume) Sleumer	√ (CF2897)	√		√ (FRI83060)	T	Native	p
Stemonuraceae	*Medusanthera gracilis* (King) Sleumer				√ (FRI84564)	T	Native	p
Stemonuraceae	*Stemonurus malaccensis* (Mast.) Sleumer	√ (FRI52858)	√			T	Native	p

Stemonuraceae	*Stemonurus umbellatus* Becc.			√	√ (FRI83016)	T	Native	p
Styracaceae	*Styrax benzoin* Dryand.				√ (BN343)	T	Native	p
Symplocaceae	*Symplocos adenophylla* Wall. ex G. Don				√ (BN431)	T	Native	p
Thymelaeaceae	*Aquilaria malaccensis* Lam.	√ (FMS9537)	√	√	√ (BN245)	T	Native	p
Thymelaeaceae	*Gonystylus confusus* Airy Shaw				√ (BN597)	T	Native	p
Torricelliaceae	*Aralidium pinnatifidum* (Jungh. & de Vriese) Miq.	√ (KEP2496)				T	Native	p
Trigoniaceae	*Trigoniastrum hypoleucum* Miq.	√ (CF2480)				T	Native	p
Urticaceae	*Poikilospermum suaveolens* (Blume) Merr.			√	√ (BN623.1)	T	Native	p
Vitaceae	*Tetrastigma rafflesiae* Planch.	√ (FRI29249)				C	Native	p
Vitaceae	*Ampelocissus cinnamomea* (Wall. ex M.A.Lawson) Planch.	√ (FMS10223)			√ (BN600)	C	Native	p
Vitaceae	*Nothocissus spicifera* (Griff.) Latiff			√	√ (BN502)	C	Native	p
Vitaceae	*Cayratia mollissima* (Planch.) Gagnep.			√	√ (BN450)	C	Native	p
Vitaceae	*Leea indica* (Burm. f.) Merr.			√	√ (FRI83031)	S	Native	s
Angiosperms (Monocots)								
Araceae	*Rhaphidophora sylvestris* (Blume) Engl.				√ (FRI83063)	C	Native	p
Araceae	*Syngonium podophyllum* Schott			√	√ (FRI83026)	C	Naturalised	s
Araceae	*Aglaonema nitidum* (Jack) Kunth				√ (BN234)	H	Native	p
Araceae	*Aglaonema simplex* (Blume) Blume				√ (FRI84560)	H	Native	p
Araceae	*Amydrium medium* (Zoll. & Moritzi) Nicolson			√	√ (FRI83017)	C	Native	p
Araceae	*Anadendrum marginatum* Schott				√ (FRI83073)	C	Native	p
Araceae	*Anadendrum microstachyum* (de Vriese & Miq.) Backer & Alderw.				√ (FRI84593)	C	Native	p
Araceae	*Epipremnum* sp. 1				√ (BN240)	C	Native	p
Araceae	*Schismatoglottis scortechinii* Hook.f.				√ (BN455)	H	Native	p

Araceae	*Scindapsus hederaceus* Miq.				√ (FRI83066)	C	Native	p
Araceae	*Scindapsus pictus* Hassk.			√	√ (BN645)	C	Native	p
Arecaceae	*Arenga obtusifolia* Mart.				√ (BN362)	P	Native	p
Arecaceae	*Arenga westerhoutii* Griff.				√ (BN464)	P	Native	p
Arecaceae	*Caryota mitis* Lour.			√	√ (BN179)	P	Native	p
Arecaceae	*Korthalsia rigida* Blume			√	√ (BN474)	P	Native	p
Arecaceae	*Oncosperma horridum* (Griff.) Scheff.				√ (BN472)	P	Native	p
Asparagaceae	*Dracaena reflexa* Lam.				√ (BN421)	S	Native	p
Asparagaceae	*Dracaena angustifolia* (Medik.) Roxb.				√ (BN415)	S	Native	p
Asparagaceae	*Peliosanthes teta* Andrews				√ (BN143)	H	Native	p
Commelinaceae	*Commelina attenuata* K.D.Koenig ex Vahl	√ (FMS13838)				H	Native	p
Costaceae	*Cheilocostus speciosus* (J.Koenig) C.D.Specht				√ (BN190)	S	Native	s
Cyperaceae	*Mapania cuspidata* (Miq.) Uittien			√	√ (BN139)	H	Native	p
Cyperaceae	*Mapania palustris* (Hassk. ex Steud.) Fern.-Vill.				√ (BN50)	H	Native	p
Cyperaceae	*Hypolytrum nemorum* (Vahl) Spreng.				√ (FRI83025)	H	Native	p
Dioscoreaceae	*Tacca integrifolia* Ker Gawl.			√	√ (BN40)	H	Native	p
Musaceae	*Musa acuminata* Colla			√	√ (FRI83064)	H	Native	s
Orchidaceae	*Dendrobium crumenatum* Sw.				√ (BN174)	E	Native	s
Orchidaceae	*Apostasia nuda* R.Br.	√ (FMS36030)				H	Native	p
Oxalidaceae	*Sarcotheca griffithii* Hallier f.	√ (157)				T	Native	p
Smilacaceae	*Smilax megacarpa* A.DC.				√ (BN463)	C	Native	p
Smilacaceae	*Smilax myosotiflora* A.DC.				√ (BN291)	C	Native	p
Xanthorrhoeaceae	*Dianella ensifolia* (L.) DC.	√ (CF6)	√			H	Native	p
Zingiberaceae	*Zingiber zerumbet* (L.) Roscoe ex Sm.				√ (BN142)	H	Native	p
Zingiberaceae	*Alpinia* sp. 1				√ (BN466)	H	Native	p
Zingiberaceae	*Elettariopsis* sp.1				√ (BN55)	H	Native	p
Zingiberaceae	*Elettariopsis triloba* (Gagnep.) Loes.				√ (FRI83034)	H	Native	p
Zingiberaceae	*Globba pendula* Roxb.	√ (KEP51743)				H	Native	p

Zingiberaceae	*Globba aurantiaca* Miq.	√ (FMS4973)	√			H	Native	p
Zingiberaceae	*Globba variabilis* Ridl.	√ (CF594)				H	Native	p
Ferns								
Adiantaceae	*Adiantum latifolium* Lam.			√	√ (FRI83018)	H	Naturalised	s
Aspleniaceae	*Asplenium nidus* L.				√ (BN126)	E	Native	p
Blechnaceae	*Stenochlaena palustris* (Burm. f.) Bedd.			√	√ (BN357)	E	Native	p
Cyatheaceae	*Cyathea latebrosa* (Wall. ex Hook.) Copel.			√	√ (FRI83030)	H	Native	s
Cyatheaceae	*Cyathea alternans* Hook.			√	√ (BN477)	H	Native	p
Davalliaceae	*Davallia denticulata* (Burm. f.) Mett. ex Kuhn				√ (FRI84598)	E	Native	s
Gleicheniaceae	*Dicranopteris linearis* (Burm. f.) Underw.			√	√ (BN334)	H	Native	s
Lygodiaceae	*Lygodium circinatum* (Burm. f.) Sw.			√	√ (BN454)	C	Native	p
Lygodiaceae	*Lygodium microphyllum* (Cav.) R. Br.				√ (FRI83032)	C	Native	s
Nephrolepidaceae	*Nephrolepis biserrata* (Sw.) Schott				√ (BN196)	H	Native	s
Polypodiaceae	*Drynaria sparsisora* (Desv.) T. Moore				√ (BN184)	H&E	Native	s
Polypodiaceae	*Microsorum punctatum* (L.) Copel.				√ (FRI84569)	E	Native	p
Polypodiaceae	*Platycerium coronarium* (Mull.) Desv.				√ (BN646)	E	Native	p
Polypodiaceae	*Pyrrosia piloselloides* (L.) M.G. Price	√ (FMS11184)		√		E	Native	s
Pteridaceae	*Pteris vittata* L.				√ (FRI83028)	H	Native	s
Pteridaceae	*Taenitis blechnoides* (Willd.) Sw.			√	√ (FRI83021)	H	Native	p
Tectariaceae	*Pleocnemia irregularis* (C. Presl) Holttum			√	√ (BN12)	H	Native	s
Tectariaceae	*Tectaria fissa* (Kunze) Holttum	√ (SFN40078)				H	Native	p
Tectariaceae	*Tectaria oligophylla* (Rosenst.) C. Chr.				√ (FRI83019)	H	Native	p
Tectariaceae	*Tectaria semipinnata* (Roxb.) C.V. Morton			√	√ (83056)	H	Native	p
Tectariaceae	*Tectaria singaporiana* (Wall. ex Hook. & Grev.) Ching			√	√ (BN399)	H	Native	p

Thelypteridaceae	*Christella parasitica* H.Lev.		√ (BN487)	H	Native	p
Thelypteridaceae	*Pronephrium menisciicarpon* (Blume) Holttum		√ (BN277)	H	Native	p
Thelypteridaceae	*Pronephrium rubicundum* (Alderw.) Holttum		√ (BN411)	H	Native	p
Woodsiaceae	*Diplazium crenato-serratum* T. Moore		√ (BN519)	H	Native	p
Lycophytes						
Selaginellaceae	*Selaginella wallichii* (Hook. & Grev.) Spring		√ (BN372)	H	Native	p
Selaginellaceae	*Selaginella willdenowii* (Desv. ex Poir.) Baker	√	√	H	Native	p

The checklist records a total of 499 plant taxa collected from BNFR corresponding to 2 lycophytes, 25 ferns, 39 monocot and 433 dicots (Table 2).

Table 2.

Number of native and naturalised taxa recorded in Bukit Nanas Forest Reserve for the different biological groups.

Biological groups	Native	Naturalised	Total
Lycophytes	2	0	
Ferns	24	1	499
Angiosperms (Monocots)	38	1	
Angiosperms (Dicots)	425	8	

The most speciose families in BNFR are Rubiaceae (32 taxa), Moraceae (23 taxa), Leguminosae (22 taxa), Myrtaceae (21 taxa), Dipterocarpaceae (16 taxa) and Euphorbiaceae (16 taxa). The largest monocot family is Araceae (11 taxa) including *Aglaonema* (2 taxa), *Amydrium* (1 taxa), *Anadendrum* (2 taxa), *Epipremnum* (1 taxa), *Rhaphidophora* (1 taxa), *Schismatoglottis* (1 taxa), *Scindapsus* (2 taxa) and *Syngonium* (1 taxa). The largest genera collected in BNFR are *Syzygium* (19 taxa), followed by *Ficus* (13 taxa), *Shorea* (8 taxa), *Artocarpus* (8 taxa), *Garcinia* (7 taxa) and *Sterculia* (6 taxa).

Among the ferns, Tectariaceae is the largest family with 5 species, followed by the Polypodiaceae with 4 species. *Tectaria* is the most speciose genus with 4 species. Only two species of lycophytes are recorded from BNFR: *Selaginella wallichii* and *Selaginella willdenowii*. *Selaginella wallichii* was found under the forest canopy but *S. willdenowii* grows in disturbed areas of BNFR.

Adiantum latifolium under the fern family is one of the naturalised species found in BNFR. This species is native to tropical America and naturalised in BNFR on the forest floor and disturbed area. Only one species, *Syngonium podophyllum* from the monocot species become naturalised on BNFR.

Graph in (Fig. 4) shown during the second decade in between 1911 to 1920, number of species increase is 127, followed by 1921 to 1930 with 117 species because in 1928 Henderson had done his survey at BNFR. After two decades, there is no new species recorded in that area since there are no significant declining or increasing number of species until year 2000. The reduction of species collected at BNFR are caused by the decrease in number of research and researcher during that period. Most of the researchers expanded their study site to other forest in Malaysia.

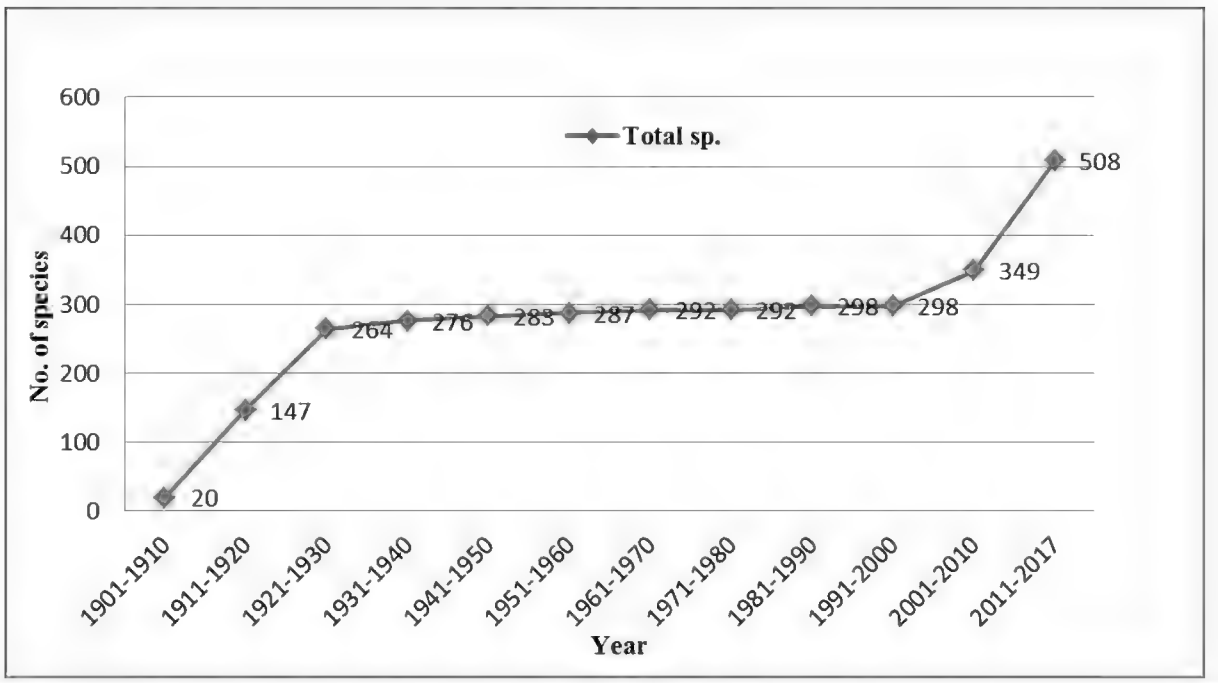

Figure 4.
Graph shown the increase number of species by decade at Bukit Nanas Forest Reserve from 1901 to 2016.

Almost 100 years later, in 2006, forest department done their survey in BNFR and recorded another 51 species. After that, our completed survey in 2015 to 2016 that covered all the trees, shrubs and herbs in Bukit Nanas area shown the highest peak of new collection of the species. Our survey collected 159 new record species including *Syzygium*, *Tabernaemontana*, *Sterculia*, *Smilax*, *Ficus*, *Garcinia*, *Artocarpus* and others. We also have the additional Dipterocarpaceae family which is *Shorea glauca* and *Shorea assamica*. In the monocot categories, we make many collections on Araceae family like *Scindapsus hederaceus*, *Schismatoglottis scortechinii*, *Aglaonema simplex*, *Aglaonema nitidum* and also Zingiberaceae (*Zingiber zerumbet*). Our collections were higher than other collections because we did the inventory regularly (3 times per month) and involved the expert around us to identify the species. Many of the collections before are not fully identified and they only focus on certain groups of plants and preliminary survey.

Forest structure

It is quite a surprise to still find some enormous trees in BNFR that appear to be several hundred years old (Table 3). From its structure and species composition BNFR is lowland dipterocarp forest (Saw 2010) and it has retained the typical three tree layers including the upper layer of emergent trees, the main stratum about 24-36 m high; and the lower layer

with smaller, shade-tolerant trees and immature trees of the upper two layers, and below the shrub and herb layers. According to JPSM (2007), BNFR never been logged and because of these, the big emergent trees still exist.

Table 3.

Big trees with the diameter at breast height (DBH) more than 50 cm in BNFR during FRIM survey 2015-2016.

DBH (cm)	Family	Species	Local name
124	Moraceae	*Ficus vasculosa*	Ara
120	Apocynaceae	*Dyera costulata*	Jelutong
120	Dipterocarpaceae	*Dryobalanops aromatica*	Kapur
110	Dipterocarpaceae	*Shorea bracteolata*	Meranti pa'ang
110	Malvaceae	*Neesia malayana*	Bengang
108	Dipterocarpaceae	*Shorea sumatrana*	Balau sengkawang ayer
105	Sapotaceae	*Palaquium obovatum*	Nyatoh
100	Calophyllaceae	*Mesua ferrea*	Penaga lilin
100	Olacaceae	*Ochanostachys amentacea*	Petaling
96	Moraceae	*Artocarpus rigidus*	Terap
90	Apocynaceae	*Alstonia angustiloba*	Pulai
90	Leguminosae	*Falcataria moluccana*	Batai
84	Dipterocarpaceae	*Anisoptera costata*	Mersawa
80	*Rosaceae*	*Prunus polystachya*	Medang kelawar
74	Meliaceae	*Azadirachta excelsa*	Sentang
70	Combretaceae	*Terminalia bellirica*	Bahera
70	Dipterocarpaceae	*Dipterocarpus baudii*	Keruing bulu
69	Anacardiaceae	*Gluta wallichii*	Rengas
60	*Lauraceae*	*Litsea castanea*	Medang kunyit
60	Leguminosae	*Callerya atropurpurea*	Tulang daing
55	Moraceae	*Ficus variegata*	Ara
53	Euphorbiaceae	*Endospermum diadenum*	Seduduk-seduduk
50	Anacardiaceae	*Gluta curtisii*	Rengas
50	Anacardiaceae	*Gluta malayana*	Rengas
50	Meliaceae	*Toona sureni*	Surian
50	Sapotaceae	*Pouteria malaccensis*	Nyatoh

Tall trees of the emergent layer in BNFR include many Dipterocarpaceae (16 species), the dominant family in Malaysian lowland rain forest, as well as *Dyera costula* (Apocynaceae),

Mesua ferrea (Calophyllaceae), *Palaquium obovatum* (Sapotaceae), *Neesia malayana* (Malvaceae), *Gluta curtisii*, *G. malayana* and *G. wallichii* (Anacardiaceae).

In the main stratum, there are a great diversity of typical lowland forest trees such as *Sindora coriaceae* (Leguminosae), *Canarium littorale*, *Dacryodes costata*, *Santiria apiculata* (Burseraceae), *Calophyllum inophyllum*, *Garcinia* spp. (Clusiaceae), *Madhuca* spp., *Palaquium* spp., *Pouteria malaccensis* (Sapotaceae), *Endocomia canarioides*, *Horsfieldia* spp., *Knema* spp. (Myristicaceae), *Artocarpus* spp. and *Ficus* spp. (Moraceae), *Syzygium* spp. (Myrtaceae) and many others.

The large palms, *Oncospermum horridum* and *Arenga westerhoutii*, are also the typical lowland forest. In the understory, treelets, such as *Chassalia chartacea* (Rubiaceae) *and Pheanthus nutans* (Annonaceae); herbs like *Tacca integrifolia* (Dioscoreaceae) and Araceae (*Aglaonema simplex* and *Schismatoglottis scortechinii*) and Zingiberaceae *(Zingiber zerumbet* and *Elettariopsis triloba*) are common.

Among the most abundance forest species recorded in BNFR (Table 4), three are ferns *(Adiantum latifolium, Pronephrium menisciicarpon* and *Stenochlaena palustris*). Two are native species of the forest floor, *Aglaonema simplex* and *Thottea tricornis. Thottea tricornis* is important because it is the food plant of the caterpillar of the yellow birdwing butterfly, one of the most spectacular in Malaysia. The shrub *Chassalia chartacea* grows along trails and under big trees.

Table 4.

The most common forest species in the Bukit Nanas Forest Reserve.

Family	**Species**
Adiantaceae	*Adiantum latifolium*
Annonaceae	*Phaeanthus ophthalmicus*
Araceae	*Aglaonema simplex*
Aristolochiaceae	*Thottea tricornis*
Blechnaceae	*Stenochlaena palustris*
Cornaceae	*Alangium griffithii*
Euphorbiaceae	*Elateriospermum tapos*
Ixonanthaceae	*Ixonanthes icosandra*
Rubiaceae	*Chassalia chartacea*
Rubiaceae	*Aidia densiflora*
Rutaceae	*Maclurodendron porteri*
Sapotaceae	*Palaquium obovatum*
Thelypteridaceae	*Pronephrium menisciicarpon*

Endemic species

Henderson (1928), who provided the first list of plants from BNFR recorded 15 species as endemic to Peninsular Malaysia compared with 35 species collected between 1901 and 2014 (Table 5).

Table 5.

Species endemic to Peninsular Malaysia recorded by Henderson (1928) (as "Hend."), BRAHMS KEP data (1901-2014) (as "BRAHMS"), JPSM (2006) (as "FD") and by FRIM survey (2015/2016) (as "15/16").

(Note, * = endemic to Selangor).

Family	Species	BRAHMS	Hend.	FD	15/16
Achariaceae	*Ryparosa fasciculata*	√			√
Achariaceae	*Scaphocalyx spathacea*	√	√		√
Anacardiaceae	*Gluta curtisii*			√	√
Annonaceae	*Alphonsea maingayi*	√	√		
Annonaceae	*Drepananthus pruniferus*	√	√		
Annonaceae	*Enicosanthum fuscum*	√			
Annonaceae	*Phaeanthus ophthalmicus*	√	√		
Annonaceae	*Xylopia subdehiscens*	√	√		
Apocynaceae	*Anodendron wrayi*				√
Apocynaceae	*Leuconotis griffithii*	√	√		
Aquifoliaceae	*Ilex maingayi*	√			
Araceae	*Schismatoglottis scortechinii*				√
Clusiaceae	*Garcinia dumosa*	√			
Dichapetalaceae	*Dichapetalum griffithii*				√
Ebenaceae	*Diospyros argentea*	√	√	√	√
Euphorbiaceae	*Ptychopyxis costata* var. *oblanceolata*	√			
Fagaceae	*Castanopsis nephelioides*	√			
Fagaceae	*Castanopsis wallichii*	√			
Fagaceae	*Lithocarpus curtisii*	√	√		
Lamiaceae	*Vitex longisepala*	√			
Lecythidaceae	*Barringtonia fusiformis*				√
Leguminosae	*Bauhinia audax*	√	√		
Leguminosae	*Crudia curtisii*	√			
Leguminosae	*Fordia albiflora*	√			
Leguminosae	*Ormosia polita*	√	√		
Malvaceae	*Kostermansia malayana*			√	√

Melastomataceae	*Oxyspora bullata*	√		√	√
Moraceae	*Artocarpus hispidus*				√
Moraceae	*Ficus aurata*	√			
Myrtaceae	*Syzygium borneense*	√	√		
Myrtaceae	*Syzygium inophyllum*	√			√
Phyllanthaceae	*Aporosa penangensis*	√			
Phyllanthaceae	*Baccaurea hookeri*	√			
Piperaceae	*Piper porphyrophyllum*	√	√		
Rhizophoraceae	*Pellacalyx saccardianus*	√			√
Rubiaceae	*Ixora kingstonii*	√			
Rubiaceae	*Lasianthus oblongus*	√	√		
Rubiaceae	*Oxyceros fragrantissimus*				√
Rubiaceae	*Psychotria penangiana*	√			
Rubiaceae	*Tarenna rudis**		√		√
Salicaceae	*Casearia clarkei* var. *kunstleri*	√	√		
Sapotaceae	*Palaquium maingayi*	√		√	√
Sapotaceae	*Palaquium oxleyanum*	√			
Zingiberaceae	*Globba variabilis*	√			
	TOTAL	35	15	5	16

Most of this increase derives from the latter surveys including all groups of plants, notably ferns, and from the more intensive collecting over a longer period. Of particular importance, however, from Henderson's list is *Tarenna rudis* (Rubiaceae), the only species endemic to Selangor (Henderson 1928). Surprisingly, after 87 years, this species still exist in BNFR and recollected again during our survey.

Recollecting these endemic species was one of the objectives of this study but in spite of regular intensive search just 16 endemic species were collected (Table 5). In term of species number it was increase compare to Henderson survey because only three species are recollected again and remaining are new record in survey. But in term of the endemic lost from Henderson survey, 12 species did not exist anymore in BNFR. This is of particular concern since endemics are species of conservation importance. Reasons for this are various. One obvious reason is that the area of BNFR is now a fraction of its original size. When the size decrease some species lost because of disruption to the development and effect of the open area that give unsuitable conditions to grow and pollinate for their survival and generation.

Example of the species not recollected are *Alphonsea maingayi* (Annonaceae), *Drepananthus pruniferus* (Annonaceae), *Phaeanthus ophthalmicus* (Annonaceae), *Xylopia subdehiscens* (Annonaceae), *Leuconotis griffithii* (Apocynaceae), *Lithocarpus curtisii* (Fagaceae), *Bauhinia audax* (Leguminosae), *Ormosia polita* (Leguminosae), *Syzygium*

borneense (Myrtaceae), *Piper porphyrophyllum* (Piperaceae), *Lasianthus oblongus* (Rubiaceae) and *Casearia clarkei* var. *kunstleri* (Salicaceae).

When we compare our recent survey with Henderson (Henderson 1928) and other botanists that collected between 1901 to 2014 only six of the species that still exist on BNFR such as *Scaphocalyx spathacea* (Achariaceae), *Diospyros argentea* (Ebenaceae) and *Tarenna rudis* (Rubiaceae), *Ryparosa fasciculata* (Achariaceae), *Syzygium inophyllum* (Myrtaceae) and *Palaquium maingayi* (Sapotaceae).

Change over time

For more than a hundred years, BNFR has been an isolated forest island in a sea of urbanisation. Although it was never logged, its size has been reduced from 17.5 ha in 1928 to 9.37 ha today and its accessibility in the centre of a busy city means it is vulnerable to disturbance. It is therefore to be expected that over the years, sensitive species will loss as the climate in the city has become hotter and less humid and many of the birds, mammals and presumably also insects that were pollinators or fruit and seed dispersers died out. Species loss is particularly conspicuous among the endemic species. Of the 267 species listed by Henderson (Table 6), 15 species are endemic to Peninsular Malaysia but after 87 years only about 20% still remain including *Tarenna rudis* that have been recollected in the BNFR.

Table 6.

List of the naturalised plants

Family	**Species**
Acanthaceae	*Asystasia gangetica* ssp. *micrantha*
Acanthaceae	*Hemigraphis reptans*
Acanthaceae	*Lepidagathis* sp. 1
Adiantaceae	*Adiantum latifolium*
Araceae	*Syngonium podophyllum*
Cleomaceae	*Cleome rutidosperma*
Compositae	*Ageratum conyzoides*
Compositae	*Crassocephalum crepidioides*
Cucurbitaceae	*Melothria pendula*
Leguminosae	*Senna sulfurea*
Leguminosae	*Senna hirsuta*
Onagraceae	*Ludwigia hyssopifolia*

The future

At the present time, the presence of tall emergent trees and a complete canopy structure provides stable cooler, humid conditions suitable for the growth and regeneration of shade tolerant shrubs and herbs. But with development, the central area has become smaller in proportion to the margin. Additionally, the edge effect with conditions of high light, high temperatures and low humidity will, on the one hand, encourage the invasion of secondary and naturalised species, while on the other hand preventing the growth and regeneration of primary rain forest species.

Native secondary forest tree species, *Macaranga tanarius, Macaranga triloba, Macaranga gigantea* and *Mallotus paniculatus* form thickets along the forest margin. The fern *Lygodium microphyllum* is most common on the forest margins. However, some naturalised exotic species are invasive or have the potential to become established within the forest because they are adapted to forest habitats, such as *Syngonium podophyllum*, *Cleome rutidosperma* and *Melothria pendula*. *Asystasia gangentica* ssp. *micrantha* is an invasive weed introduced in the 1970s but is now naturalised and widespread and ubiquitous (Kiew and Vollescen 1997).

Secondary species and weeds are light demanding so if forest structure is not disturbed nor fragmented, they are unable to penetrate into the forest and therefore cannot compete with primary forest species. Over time, secondary forest trees can form a stable canopy. The shade demanding forest species can invade and become established and eventually grow taller and overshadow the secondary forest trees. Gradually over time primary forest species will replace the secondary ones. However, this depends on a seed source and being an island in a sea of urbanisation, recruitment of primary forest species can only be obtain from the existing stocks.

Using IUCN categories and criteria, five species was categorized as nearly threatened such as Dipterocarpaceae family including *Anisoptera costata*, *Shorea sumatrana* and two other species, *Magnolia montana* and *Memecylon campanulatum* (Table 7). In BNFR, there is only one tree of *Shorea sumatrana* with the diameter of 108 cm. The area where it grows needs to be protected to conserve the tree and enable its saplings to become established to ensure this species is not lost from BNFR.

Table 7.

List of the endangered species in BNFR based on Flora Peninsular Malaysia (Kiew et al. 2010, Kiew et al. 2011, Kiew et al. 2012, Kiew et al. 2013, Kiew et al. 2015, Parris et al. 2010, Parris et al. 2013) and Malaysia Plant Red List (Chua et al. 2010).

Family	Species	Conservation Status
Dipterocarpaceae	*Anisoptera costata*	NT
Dipterocarpaceae	*Shorea dasyphylla*	VU
Dipterocarpaceae	*Shorea sumatrana*	NT
Magnoliaceae	*Magnolia montana*	NT

Melastomataceae	*Memecylon campanulatum*	NT

Cultivated species

Another source of invasive plants is from the planting of both of the native and exotic ornamental species around the Forest Department Information Centre and along paths (Table 8). One example is the ornamental *Dioscorea zanzibarica*, a most invasive species that is recorded in the Bukit Nanas area. Another species found in the open and near the canopy area is *Hemigraphis reptans*, an invasive shade-tolerant species that should be removed to prevent its spread. These two species need to be monitored to prevent their spread and impact on the natural habitat. The other problem is the addition of several native tree species, such as *Hopea odorata*, *H. helferi* and *Vatica pauciflora*, planted around the Visitor Centre and along the trails. If they become established, they will merge into the forest area and, in future, it will not be possible to distinguish the original BNFR forest species from those brought in. Care needs to be taken to maintained the original forest and to prevent the invasion of both exotic species and native species brought in from elsewhere.

Table 8.

List of the cultivated species planted in Bukit Nanas Forest Reserve.

Family	**Species**	**Categories**
Acanthaceae	*Clinacanthus nutans*	Native
Acanthaceae	*Hemigraphis reptans*	Naturalised
Acanthaceae	*Justicia vulgaris*	Naturalised
Acanthaceae	*Strobilanthes crispus*	Naturalised
Achariaceae	*Pangium edule*	Native
Amaryllidaceae	*Crinum asiaticum*	Native
Anacardiaceae	*Mangifera indica*	Native
Anacardiaceae	*Mangifera quadrifida*	Native
Annonaceae	*Polyalthia bullata*	Native
Annonaceae	*Polyalthia longifolia* var. *pendula*	Native
Araceae	*Aglaonema nitidum* × *comutatum*	Naturalised
Araceae	*Alocasia* sp. 1	Native
Araucariaceae	*Agathis borneensis*	Native
Arecaceae	*Areca catechu*	Native
Arecaceae	*Johannesteijsmannia altifrons*	Native
Arecaceae	*Livistona rotundifolia*	Naturalised
Arecaceae	*Pinanga disticha*	Native
Arecaceae	*Pinanga* sp. 1	Native

Arecaceae	*Rhapis excelsa*	Native
Asparagaceae	*Dracaena fragrans*	Naturalised
Bignoniaceae	*Tabebuia rosea*	Naturalised
Bromeliaceae	*Ananas nanus*	Naturalised
Cactaceae	*Pereskia sacharosa*	Naturalised
Cibotiaceae	*Cibotium barometz*	Native
Combretaceae	*Terminalia subspathulata*	Native
Cycadaceae	*Cycas macrocarpa*	Native
Dioscoreaceae	*Dioscorea zanzibarica*	Exotic
Dipterocarpaceae	*Dipterocarpus chartaceus*	Native
Dipterocarpaceae	*Hopea helferi*	Native
Dipterocarpaceae	*Hopea odorata*	Native
Dipterocarpaceae	*Hopea pierrei*	Native
Dipterocarpaceae	*Neobalanocarpus heimii*	Native
Dipterocarpaceae	*Shorea*	Native
Dipterocarpaceae	*Shorea singkawang*	Native
Dipterocarpaceae	*Vatica cuspidata*	Native
Dipterocarpaceae	*Vatica pauciflora*	Native
Euphorbiaceae	*Aleurites moluccana*	Native
Euphorbiaceae	*Hevea brasiliensis*	Naturalised
Euphorbiaceae	*Jatropha curcas*	Native
Gentianaceae	*Fagraea fragrans*	Native
Gnetaceae	*Gnetum gnemon*	Native
Gramineae	*Bambusa multiplex*	Native
Gramineae	*Bambusa ventricosa*	Exotic
Gramineae	*Bambusa vulgaris*	Native
Gramineae	*Gigantochloa scortechinii*	Native
Gramineae	*Isachne albens*	Native
Gramineae	*Schizostachyum brachycladum*	Native
Gramineae	*Schizostachyum jaculans*	Native
Guttiferae	*Garcinia atroviridis*	Native
Guttiferae	*Garcinia mangostana*	Native
Hamamelidaceae	*Maingaya malayana*	Native
Heliconiaceae	*Heliconia psittacorum*	Naturalised
Labiatae	*Clerodendrum paniculatum*	Native
Labiatae	*Orthosiphon stamineus*	Naturalised
Labiatae	*Plectranthus monostachyus*	Native

Lauraceae	*Cinnamomum iners*	Native
Leguminosae	*Bauhinia kockiana*	Naturalised
Leguminosae	*Delonix regia*	Naturalised
Leguminosae	*Koompassia excelsa*	Native
Leguminosae	*Koompassia malaccensis*	Native
Leguminosae	*Peltophorum pterocarpum*	Native
Leguminosae	*Tamarindus indica*	Native
Lythraceae	*Lagerstroemia speciosa*	Naturalised
Malvaceae	*Durio zibethinus*	Native
Malvaceae	*Sterculia foetida*	Native
Marantaceae	*Donax canniformis*	Native
Marantaceae	*Phrynium pubinerve*	Native
Marattiaceae	*Angiopteris evecta*	Native
Meliaceae	*Azadirachta indica*	Naturalised
Meliaceae	*Lansium domesticum*	Native
Meliaceae	*Swietenia macrophylla*	Naturalised
Menispermaceae	*Tinospora crispa*	Native
Myristicaceae	*Myristica fragrans*	Native
Myrtaceae	*Syzygium aromaticum*	Native
Myrtaceae	*Syzygium campanulatum*	Native
Myrtaceae	*Tristaniopsis whiteana*	Native
Orchidaceae	*Cymbidium finlaysonianum*	Native
Pandanaceae	*Pandanus amaryllifolius*	Native
Pandanaceae	*Pandanus soboliferus*	Native
Pandanaceae	*Pandanus utilis*	Native
Phyllanthaceae	*Phyllanthus emblica*	Native
Podocarpaceae	*Podocarpus polystachyus*	Native
Podocarpaceae	*Podocarpus rumphii*	Native
Pteleocarpaceae	*Pteleocarpa lamponga*	Native
Rubiaceae	*Gardenia tubifera*	Native
Rubiaceae	*Ixora javanica*	Native
Rutaceae	*Citrus aurantifolia*	Native
Rutaceae	*Murraya paniculata*	Native
Sapindaceae	*Lepisanthes alata*	Native
Sapindaceae	*Nephelium lappaceum* var. *lappaceum*	Native
Sapotaceae	*Mimusops elengi*	Native
Simaroubaceae	*Eurycoma longifolia*	Native

Stemonaceae	*Stemona curtisii*	Native
Zingiberaceae	*Curcuma longa*	Native
Zingiberaceae	*Etlingera elatior*	Native
Zingiberaceae	*Kaempferia pulchra*	Native

Conclusion

Bukit Nanas Forest Reserve is the only forest in the city that gives a green view surrounding. It must be maintained to provide good conditions for the development of the trees and become a reference centre for learning in the future. Our study provides the baseline data for the existing flora 88 years after it was inventoried by Henderson in 1928 and also records the existence of new and introduced species into this area that become invasive and naturalised. Bukit Nanas Forest Reserve is still categorised as a good forest with good forest structure and diversity because there are still many species, especially large trees that form the emergent layer and a complete tree canopy that provide cool, humid, shaded conditions for the shrubs and herbs below. In this area, the management department of forestry also grows some of the forest species and exotic plants to close the open area caused by the constructions. However, the operation and management of these introduce species into the area must be controlled to prevent taxonomic confusion in the future. In addition, the area is also increasingly disturbed by the construction of a pedestrian. Therefore, the management department of forestry must have the good plan structure for future conservation.

Bukit Nanas Forest Reserve had the privilege to serve as biodiversity centre, research, education, recreation, tourism, heritage and green lung area with monitoring and rigorous forest management. With an area of 9.37 ha, BNFR provides a good habitat for a diversity of plants and mammals.

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